



ComVantage

284928

*Collaborative Manufacturing Network
for Competitive Advantage*

D9.4.1 – Report on subjective data findings
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Executive Summary

This deliverable is the first of two deliverables that report on the evaluation of subjective data, aimed at capturing the potential business impacts of *ComVantage* by empirically assessing the attitudes of various stakeholders in the supply chain. This deliverable is focused on the process of developing the measurement instrument, a questionnaire for a web-based survey, and the outcome of this process. This deliverable presents the relevant theoretical background, the methodology used to construct the questionnaire, the decisions made, and the resulting questionnaire, platform, and administration plan.

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1 OVERVIEW

1.1 Introduction

This deliverable is concerned with the development of an instrument, aimed at capturing the potential business impacts of *ComVantage*, by empirically assessing the attitudes of various stakeholders in industrial supply chains. The purpose of this document is to describe in detail the development procedure and its outcome. The development process is comprised of three elements: instrument development, platform selection, and administration planning. Each of these elements is discussed by presenting the relevant literature, the methodological considerations, the final decisions, and the resulting outcomes.

1.2 Scope of this Document

Task 9.4 is part of WP9, whose purpose is to evaluate the potential organisational (operational and strategic) contribution of the *ComVantage* platform. Task 9.4 is designed to serve this purpose by collecting and analysing the subjective assessments of various stakeholders in industrial supply chains. The present deliverable focuses on the first part of the subjective data evaluation – the development of the measurement instrument that will serve for data collection. The subsequent deliverable will report on the results of data analysis, gained through the use of advanced modelling tools and statistical techniques.

Relevant academic background is presented in Section 2, followed by a description of the methodology for instrument development and technological platform selection in Section 3. The decisions made and their outcomes (the questionnaire, selected platform, and administration plan) are presented in Section 4. The document is finalised in Section 5 with a discussion of the process and the next steps to be taken.

1.3 Related Documents

This deliverable is the first of two deliverables (Report on subjective data findings - D9.4.1, D9.4.2) concerned with the evaluation of subjective data, the objective of T9.4. The task, in turn, is part of the overall evaluation effort in the *ComVantage* project, the purpose of WP9. The evaluation roadmap, detailed in D9.1 - Evaluation Framework (Levi et al., 2012), presents three parallel processes in the second (current) phase of the evaluation: process simulation, presented in D9.3.1 and D9.3.2 (Simulation Analysis Report), the evaluation of subjective data, presented in this document and in D9.4.2, and the evaluation of objective data to be reported in D9.5 (at M30). All evaluation efforts are guided by the evaluation framework, developed in the first year of the project and presented in D9.2.1 – Multidimensional metric set (Raphaeli, Naveh, Levi, et al., 2012)

2 BACKGROUND

A survey is a commonly used methodology for information gathering, by asking respondents about their experiences, attitudes or knowledge (Graziano & Raulin, 2007). In particular, surveys can effectively and efficiently evaluate stakeholder perceptions and attitudes for a variety of purposes, including monitoring the impact of programs and providing input for future decisions (Rogelberg & Stanton, 2007). Surveys are widely used because they offer an easy, quick, relatively inexpensive, and accurate way to collect data (Alreck & Settle, 2004).

Two general types of surveys exist. The first type is a status survey, i.e. a survey that describes the current state of a population, whereas the second type is a research survey, which is frequently used to test the relationship between variables (Graziano & Raulin, 2007). Since the current study is aimed at uncovering the impact of specific Information and Communication Technology (ICT) on business performance, it falls under the latter category.

One of the major possible weaknesses of using surveys as a methodology for data collection is low response rate (Alreck & Settle, 2004; Rose et al., 2007). Response rate is defined as the number of returned

questionnaires divided by the net sample size. Low response rate may decrease statistical power and limit the types of statistical procedures that can be applied to the data (Rogelberg & Stanton, 2007). More importantly, low response rate may create nonresponse bias. Response bias is the result of non-random distribution between prospective respondents who choose to participate in the survey and those who choose not to, as a result of individual differences in characteristics, attitudes, values, and capabilities. These differences may imply that the respondents do not represent a random sample of the population, thus undermining the generalisability of the collected data (Rogelberg & Stanton, 2007). The current study is concerned with a relatively broad spectrum of technologies and performance indicators, suggesting the absence of a direct association between the information gathered in the survey and the probability of response from prospective respondents, thus nonresponse bias is expected to be low (Alreck & Settle, 2004).

Studies show that response rate in online surveys is even lower than in surveys conducted with paper and pencil (Cook et al., 2000). To address this challenge, some standard methods for elevating response rates may be used (Stanton & Rogelberg, 2001). Advance notice - notifying the prospective respondents in advance that they are about to receive an invitation to fill out a survey - is one method found to increase response rate. Incentives, monetary or other, are another method often used. Clear and persuasive introductions to the survey may also boost response rate, as well as sending reminders to fill out the survey (Stanton & Rogelberg, 2001).

In the domain of the business value of ICT, the use of surveys is very common. For example, Sanders & Premus (2005) evaluated a conceptual model depicting the relationships among firm IT capability, internal and external collaboration, and firm performance using a survey emailed to 2,000 industrial companies. Sanders (2008) electronically surveyed 1,000 suppliers in the United States to examine relationships among patterns of IT use, organisational coordination, and organisational benefits. Jeffers et al. (2008) used an emailed questionnaire to reveal that tacit, socially complex resources explain the variation in business process performance.

Based on this background, a web-based survey was developed to evaluate the organisational impacts of *ComVantage*, as detailed next.

3 METHODOLOGY

The development of the instrument for subjective data collection was comprised of three elements. The first element, described in the following section (3.1), is concerned with the development of the instrument to be used for data collection – the questionnaire. The second element, described in Section 3.2, is focused on the selection of the technological platform to be used to distribute the survey. The third element, described in Section 4.3, is concerned with the planning of the data collection administration, i.e. the target population, schedule of data collection, medium, and incentives.

3.1 Instrument Development

The purpose of the questionnaire is to assess the potential effects of *ComVantage* on organisational performance, based on the evaluation framework developed in the first year of the project (see Figure 1, for details see D9.2.1 - Multidimensional metric set (Raphaeli, Naveh, Levi, et al., 2012). The framework is comprised of four pillars: ICT (*ComVantage* technologies), collaborative capabilities, operational performance (business process performance), and strategic performance (competitive advantage) (see Figure 1). Therefore, the questionnaire should have four corresponding sections to operationalise (measure) these four pillars (theoretical constructs), including multi-item measures for each aspect as proposed by Churchill (1979). A fifth section in the questionnaire should be devoted to the characteristics of the respondent (seniority, position etc.) and the organisation (industry, size etc.), since they are expected to moderate the relationships between ICT and organisational performance. These characteristics will also allow us to

perform analyses specifically relevant to the *ComVantage* setting (based on organisational size, role in the supply chain, etc.) and to compare it with other settings (e.g., small-medium versus large organisations).

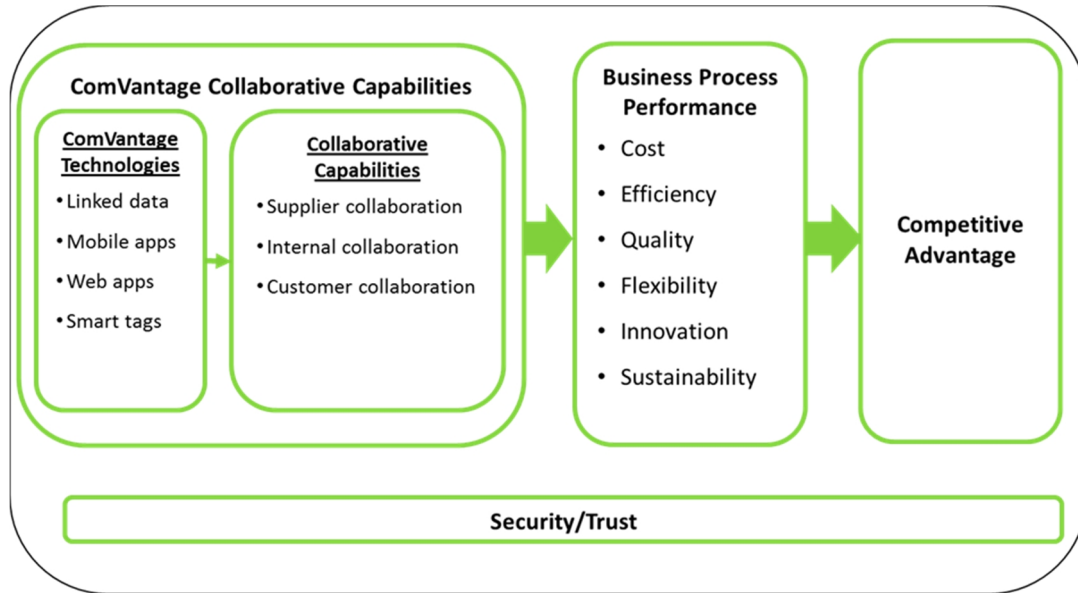


Figure 1: Evaluation framework

The development of the questionnaire followed the standard methodologies in academic research (Straub et al., 2004). The process was performed in four steps (Figure 2), starting with a literature review to identify relevant existing instruments as suggested by Churchill (1979), followed by an internal workshop aimed at adapting the instruments found in the literature to the current study, and concluding with two procedures (pre-test and pilot) to refine and validate the developed instrument. These four steps of the instrument development process are detailed next.



Figure 2: Instrument development process

3.1.1 Literature Review

A thorough review of the academic literature revealed numerous scales (i.e., a group of measurement items designed to measure a specific theoretical construct) developed to measure various aspects of the relationship between ICT and organisational performance. Following the guidelines of Churchill (1979), the scales found in the literature were analysed to examine the extent to which their conceptual and operational definitions fit the conceptual definitions of the constructs in the evaluation framework (Figure 1). This process resulted in the identification of the most suitable scales for each of the pillars of the framework (ICT, collaborative capabilities, business process performance, and competitive advantage).

The adaptation of the scales found in the literature to the current study, as well as the generation of new scales and measurement items, were performed in the second step of the instrument development process, as described in the next section.

3.1.2 Internal Workshop

In order to adapt the scales identified in the literature as relevant to the current study, an internal workshop was organised. The participants were experts in the relevant fields: business value of ICT, questionnaire construction and administration, and the *ComVantage* project. The new scales were generated either by adapting the original items, when those were found to be suitable, to the context of the current study or by developing new items, when no existing relevant items were found in the literature.

At the end of the workshop, a draft of the questionnaire with 68 items was ready for the next phase of development, the pre-test, as described in the next section.

3.1.3 Pre-test

The pre-test phase was aimed at verifying the clarity of the questionnaire, as well as its comprehensibility, relevance, and completeness. These objectives were achieved by interviewing experts in the field and representatives of the target population of the questionnaire, while going over the instrument item by item. Three experts from academia and four managers from various industries (engineering, services, manufacturing, and software development) were interviewed separately. Since questionnaire development is conducted in Israel and the target population is European, it was important to receive feedback from a European expert. Thus, one of the managers interviewed was based in Germany.

3.1.4 Pilot

The next and last step of the questionnaire development process was to pilot test the instrument, on the platform to be used when the survey will be distributed to the target population. The questionnaire was uploaded to the survey platform and technological tests were conducted to ensure the possibility of filling it out in various devices (iOS, android, desktop etc.). Next, the survey was distributed to a convenience sample of a few dozen Israeli managers in various industries and management levels. The collected data was statistically analysed using SPSS[®] (software package for statistical analysis by IBM) to identify items with skewed distributions (means are either excessively high or excessively low), excessively low variance, or low correlations with other items of the same scale.

The process of selecting the technological platform to be used to distribute the questionnaire and administer the survey is detailed next.

3.2 Platform Selection

Numerous technological platforms exist to facilitate the administration of online surveys. The process of selecting the platform to be used in the current study was thorough and comprehensive and it was comprised of four steps, as shown in Figure 3 and detailed next.



Figure 3: Platform selection process

The first step was to survey the platforms available on the market and their dominant features. This was done by keying the terms 'survey tool' and 'survey tool comparison' on Google, and following the links in the first page.

Next, a list of specific requirements of the current study was established, in order to use these requirements as criteria for comparing and selecting the best platform for this study. The requirements were generated and analysed in an internal workshop with the personnel involved in the study, using a brainstorming technique to gather all key features. Some requirements were defined as a threshold and a few survey tools were excluded from further examination because they failed to meet these threshold requirements.

In the following phase, the relevant information on each of the platforms was gathered via their websites, blog posts, and papers. To complete missing information and to have reliable information about specific features, enquiries were sent to some of the software companies managing the platforms.

The final step involved grading each of the survey tools in each of the criteria on a scale that ranges from 1 (lowest fit to requirements) to 3 (best fit to requirements) and calculating the total weighted grade for each platform. The chosen platform was the one with the highest weighted grade.

The details of the decisions made in the processes described above and the outcomes of those decisions (questionnaire, platform, and administration procedure) are described in the next section.

4 Decisions

This section details the outcomes of carrying out the methodology described in the previous section regarding instrument development and platform selection, as well as the decisions made regarding survey administration.

4.1 Instrument

As detailed in Section 3 (methodology), the development of the survey instrument began with a search of the academic literature for existing instruments and scales for measuring ICT implementation, collaborative capabilities, business process performance, and competitive advantage. The search and analysis of the relevant literature resulted in four groups of scales. Two groups corresponded with two pillars in the evaluation framework: collaborative capabilities (the degree of collaboration with suppliers, customers, and within the organisation) and competitive advantage (the degree to which the organisation holds a superior competitive position in its environment). The scales for collaborative capabilities (Part B in the questionnaire, see Appendix I) were adapted from Hsue et al. (2008) and Sanders & Premus (2005), and the scale for competitive advantage (Part D in the questionnaire, see Appendix I) was adapted from Li & Zhou (2010). The other two groups of scales adapted from the literature were concerned with the respondent and the organisation (Part E in the questionnaire, see Appendix I), and were adapted from Rosenzweig (2009), Fink & Sukenik (2011), and Fink & Neumann (2009).

The two remaining pillars in the evaluation framework – the technology and business process performance – are somewhat unique to the current study. The technology being evaluated is relatively new and therefore very little has been published about it. The operational performance pillar draws on the multidimensional metric set developed in T9.2 (for details see D9.2.2 – Multidimensional metric set (Raphaeli, Naveh, Fink, et al., 2012)), a specific set of operational performance indicators, categorised into six groups of operational aspects and adapted to the application areas of the project. Therefore, these two pillars required the generation of specific scales, which could not be adapted from the existing literature.

Thus, a workshop was held in order to adapt the relevant scales found in the literature to the current study and to generate new scales for the two unique pillars. The outcome of this phase was a first draft of the questionnaire (see Appendix I), containing five parts. The first four parts (A-D) corresponded to the four pillars of the evaluation framework (ICT, collaborative capabilities, business process performance, and competitive advantage), whereas the fifth part was devoted to collecting background information (the moderating variables). Questionnaire items used seven-point Likert scales anchored mostly with "very low" and "very high" or with "not at all" and "very high".

In the next phase, as detailed in Section 3, a pre-test of the questionnaire was conducted, resulting in a total of approximately 60 comments made by the interviewees (see Appendix II), some of which were made by more than one interviewee. Each comment was meticulously examined by the project team. The majority of the recommendations were accepted, while some comments were rejected due to their low alignment with the survey's objectives, contradictions with other comments, or technical limitations. The full list of

comments and the corresponding decisions are listed in Appendix II. The updated and final version of the questionnaire used in the next phase, the pilot, is presented in Appendix III.

In the pilot phase, the questionnaire was distributed to a convenience sample of a few dozen managers, via the selected platform. The platform selection process is described next.

4.2 Platform

As detailed in Section 3, the platform selection process began with a Google search aimed at identifying the dominant survey tools in the market. This search resulted in the identification of eight platforms: Questchain, FluidSurveys, Google forms, Kwiksurveys, QuestionPro, Survey tool, Survey Gizmo, and Survey monkey.

Next, a list of project-specific requirements was created, based on the particular research objectives and setting. The criteria are detailed in the next section, followed by the evaluation of each platform according to these criteria.

4.2.1 Selection Criteria for Survey Tool

The list of criteria formulated by the research team was based on the objective of providing the respondent with a convenient and aesthetic experience that will be accessible anytime and anywhere. The requirements represent considerations of technology, company, support, cost, functionality, security, and design:

- Automatic adaptation of display to device – because the prospective respondent may view the invitation and fill out the questionnaire on various devices (mobile phone, tablet, desktop computer etc.), it is important to ensure that the display can be automatically adapted to various devices, without the need to indicate the specific device the respondent is using. This consideration is particularly important in *ComVantage*, which focuses on increasing the functionality of mobile devices.
- Automatic adaptation of display to browser and resolution – different respondents may use different internet browsers and screen resolutions; to make sure that the questionnaire is presented adequately to all respondents, the display should be automatically adjusted to the user's browser and screen resolution.
- Technical support – to ensure that malfunctions, if they occur, are treated in a speedy and effective manner, it is necessary to use a tool that has effective technical support that is available 24/7. Such support will reduce to minimum the chances that a prospective respondent will not be able to participate in the survey because of technical difficulties.
- Company reputation – a reliable and enduring company reputation is required in order to ensure the availability and quality of the survey. Using a survey tool of such a company increases the chances of a successful data collection process.
- Customers – since the current survey is designed to answer a research question, a company with experience in academic research is preferable because of its know-how of the needs and requirements of research surveys. Therefore, previous use of the tool in research surveys is considered an important criterion.
- Cost – the cost of survey tools varies from free to hundreds of dollars per month. It is, of course, desirable to reduce to minimum the cost of using the tool.
- Feature limitations – some survey tools limit the number of questions in a survey, the number of responses to a survey, or the number of surveys the user can generate. It is important to make sure that any limitations of the platform will not contradict the requirements of the present study.
- Design and functionality – survey tools offer numerous features to facilitate the generation and administration of visually-pleasant and easy-to-use surveys. Some of these features may be valuable by increasing response rate or by providing more information about the data collection process.

- Data export – in order to use the collected data in advanced statistical analyses, it is crucial to be able to export the data to various data analysis packages.
- Information security – information security is important for two major reasons. First, respondents should feel that the data they provide is secured and is not exposed to any third party. Second, the research team would like to be sure that the data collected is always available for analysis and that its integrity is not compromised by cyber threats.
- Advertisements – some survey tools present ads (of the tool itself or of third parties) as part of the survey, while some other indicate that the survey is 'powered by' them. To ensure the academic look-and-feel of the survey, it is preferable that no logos are presented on the survey pages.

As detailed in the methodology section, the weight of each criterion in the final score was determined by the members of the research team (see Table 1), based on their experience with survey administration. The highest weight (12.5%) was assigned to the possibility to export data from the survey tool to data analysis packages, because very little can be learned from the collected data without it, and to the technical support of the tool, because a technical failure may put all the effort invested in the survey to waste. The lowest weight (5%) was assigned to cost, because the use of the survey tool is limited to several weeks and thus the cost will not be excessive, even for relatively expensive tools. The other weights range from 7.5% (feature limitations, design and functionality, information security, and advertisements) to 10% (company reputation, customers, automatic adaptation of display to device and automatic adaptation of display to browser and resolution). Higher weights were assigned to criteria related to the reliability of the company and display adaptation because of their importance for response rate, whereas lower weights were assigned to functionality, security, and advertisements because the requirements of the study in these aspects are relatively modest.

Criterion	Weight	Threshold
Automatic adaptation of display to device	10%	No
Automatic adaptation of display to browser and resolution	10%	No
Technical support	12.5%	Yes
Company reputation	10%	Yes
Customers	10%	No
Cost	5%	No
Feature limitations	7.5%	No
Design and functionality	7.5%	No
Data export	12.5%	Yes
Information security	7.5%	No
Advertisements	7.5%	No
Total	5275%	

Table 1: Weighted criteria and thresholds for platform selection

It was decided that some criteria are crucial and therefore should be considered as a threshold (see Table 1). Company reputation is critical as it is considered to be an indicator of reliability, and thus provide confidence

that the process will run smoothly. For the same reason, a high level of technical support is mandatory to ensure the quick resolution of problems during data collection. The third and last threshold is the ability to export data from the survey tool to data analysis packages because such analysis is critical to gaining insight from the study. As a consequence of applying these thresholds, some of the survey tools examined were excluded from further examination: Google forms could not offer quick and trustworthy support, whereas FluidSurveys and Kwiksveys were established less than five years ago, failing to meet the company reputation criterion.

4.2.2 Survey Tool Evaluation

Next, information was collected about each of the remaining platforms for the various criteria (see phase 3 in Figure 3), as presented in Table 2.

Based on the information gathered, three possible levels of fit, ranging from 1 (lowest fit to requirements) to 3 (best fit to requirements), were defined for each criterion. For example, for the customers criterion, 1 indicates that the company has no academic customers, 2 indicates that the company has few and/or small academic customers, and 3 is assigned if the company has many and/or large and well-known academic customers. The complete list of fit levels is presented in Table 3.

Next, each platform was assigned a grade in each criterion. The grades assigned to each platform in each criterion are presented in Table 4. The total weighted grades, also included in the table, show that the selected platform should be QuestionPro, which received the highest weighted grade (2.63).

4.3 Administration

The survey is designed to gather reliable and valid data that complies with the research objectives from as many respondents from the target population as possible. To meet these goals, careful planning of the various aspects of the data collection process was conducted. The relevant issues, the considerations guiding them, and the decisions made are detailed next.

4.3.1 Target Population

One of the first decisions to be made in designing a survey is the target population, from which the survey respondents will be sampled. Since the objective of the current research is to evaluate the potential organisational impacts of *ComVantage*, the target population is comprised of personnel at all managerial levels, ensuring the collection of data from various hierarchical perspectives. This approach of targeting a wide range of stakeholders was also adopted at the organisational level, resulting in no limitation on the industry to which the organisation belongs or on the role of the organisation in the supply chain.

4.3.2 Schedule

The timing of survey distribution and its duration are important factors in reaching a broad audience. Distribution of the survey in a less optimal timing might negatively influence the response rate and therefore considerable thought was put into finding the best time for distribution. In principle, the aim was to find a time in which the prospective respondent will be as less busy as possible and more available to fill out the questionnaire. It was also important to choose the optimal time in terms of email overload, to minimise the likelihood that the invitation to participate in the survey will be forgotten at the bottom of the respondent's inbox. For the above reasons, a time that is not close to holidays and weekends was chosen – the beginning of May, starting in the middle of the week (Wednesday).

Another scheduling decision to be made is the duration of the survey and the number and interval of reminder notices to be sent to respondents. It was found that two reminder notices, with an interval of about two weeks, produce the most effective response rate to surveys (Graziano & Raulin, 2007). Thus, two reminders will be sent, with an interval of two weeks.

Criterion/ platform	Questchain	QuestionPro	Survey tool	Survey Gizmo	Survey monkey
Automatic adaptation of display to device	No adaptation to device	Automatic adaptation to widely used mobile devices	No adaptation to device	Automatic adaptation to widely used mobile devices	Automatic adaptation only to iOS
Automatic adaptation of display to browser/resolution	Adaption to all widely used browsers and resolutions	Adaption to all widely used browsers and resolutions	Adaption to all widely used browsers and resolutions	Adaption to all widely used browsers and resolutions	Adaption to all widely used browsers and resolutions
Technical support	Phone and email support on working hours	24/7 chat, answer to email within an hour	Phone and chat on working hours, answer to email within 24 hours	Phone and email support on working hours	24/7 email, answer within 2 hours
Company reputation	Locally active in Israel, founded in 2007.	Very well known, founded in 2002, customers among 100 fortune companies	Locally active, founded in 2006.	Very well known, founded in 2006, customers among 500 fortune companies	Very well known, founded in 1999, all 100 fortune companies are customers
Customers	Industry: Alvarion, Magen David Adom in Israel. Academia: The Interdisciplinary Centre Herzliya, Ruppin College	Industry: Microsoft, Honeywell, etc. Academia: Harvard, Stanford, Berkeley.	Industry: Cisco, IBM, etc. No information about academic customers	Industry; Disney, Apple, etc. Academia: Boston University, Carnegie Mellon, etc.	Industry: Facebook, Audi, etc. No information about academic customers
Cost	49\$ per month (pro account)	100\$ per month (corporate account)	24\$ per month (pro account)	75\$ per month (business account)	20\$ per month (selected account)
Feature limitations	None	None	None	500,000 invitations per month	1,000 responses per month

Criterion/ platform	Questchain	QuestionPro	Survey tool	Survey Gizmo	Survey monkey
Design and functionality	18 types of questions, no themes, some additional features	30 types of questions, 20 themes, advances features	19 types of questions, 40 themes, some additional features	28 types of questions, 13 themes, advanced features	15 types of questions, 25 themes, advanced features
Data export	XLS	CSV, XLS	XLS	CSV, SPSS	CSV, XLS, SPSS
Information security	SSL using cookies	SSL using cookies	SSL, possible to inactivate cookies	SSL using cookies	SSL using cookies
Advertisements	Platform's logo on pages	'Powered by' logo at the bottom of the page	Information not available	'powered by' logo at the bottom of the page	User can choose to add ads

Table 2: Platforms criteria information

Criterion	Level 1	Level 2	Level 3
Automatic adaptation of display to device	No automatic adaptation	Automatic adaptation to some devices	Automatic adaptation to all widely-used devices
Automatic adaptation of display to browser and resolution	No automatic adaptation	Automatic adaptation to some browsers and to some resolutions	Automatic adaptation to all widely used browsers and resolutions
Technical support	During working hours	During working hours, answer to email in 24 hours	24/7, answer in less than 4 hours
Company reputation	Locally active, small customer base, established less than 7 years ago	Medium geographical reach and/ or customer base, established less than 10 year ago	Active worldwide, large customer base, established more than 10 years ago
Customers	No academic customers	Few, not well known academic customers	Large amount of academic customers, well known academic institutes
Cost	More than \$70 per month	\$35-\$70 per month	Less than \$35 per month
Feature limitations	Less than 500 responses per month	Less than 1,000 responses per month	No limitations
Design and functionality	Few themes and question types	Intermediate amount of themes and question types, some advanced features	Numerous themes and question types, advanced features
Data export	Possible for some packages	Possible for some widely-used packages	Possible for all widely-used packages
Information security	No special security features	Use SSL and cookies	SSL
Advertisements	Platform logo	'Powered by'	No platform indication

Table 3: Levels of fit of criteria to project's requirements

Criterion/ platform	Weight	Quest- chain	Question- Pro	Survey tool	Survey Gizmo	Survey monkey
Automatic adaptation of display to device	10%	1	3	1	3	2
Automatic adaptation of display to browser/resolution	10%	3	3	3	3	3
Technical support	12.5%	1	3	2	1	3
Company reputation	10%	1	3	1	3	3
Customers	10%	2	3	1	3	1
Cost	5%	2	1	3	1	3
Feature limitations	7.5%	3	3	3	3	2
Design and functionality	7.5%	2	3	3	3	3
Data export	12.5%	1	2	1	2	3
Information security	7.5%	2	2	3	2	2
Advertisements	7.5%	1	2	1	2	3
Total grade		1.65	2.63	1.88	2.38	2.55

Table 4: Platforms grading

4.3.3 Medium

The email inviting prospective respondents to take part in the survey will be distributed by *ComVantage* partners to their business partners. Hopefully, the respondents will continue to forward the invitation to their partners, generating a viral distribution. Another option for distribution is the use of social networks. Therefore, a link to the survey will be posted on the project's twitter account and on the Facebook account of key WP9 project members. Another possible distribution channel to be examined is the FInES cluster and other European Union Seventh Framework Programme projects.

4.3.4 Incentives

In order to mitigate the risk of low response rate, careful thought was put into creating incentives for filling out the questionnaire. Two optional incentives will be offered to respondents. The first incentive is of business value to the respondents – providing them with an executive summary of the results of the survey, which may be relevant and applicable to the respondent's organisation. The second incentive is a personal financial incentive, which is commonly used to increase response rate (Porter & Whitcomb, 2003). Thus, three vouchers of \$100 each, a sum found to be positively correlated to significantly higher response rates (Porter & Whitcomb, 2003), will be given to randomly selected respondents who will complete the survey and will be willing to enter their email address for this purpose. We believe that these incentives will help produce an acceptable response rate and will help collect data from a large enough sample to generate meaningful and insightful results, based on the analysis to be performed on the collected data.

5 CONCLUSION AND OUTLOOK

The elaborate process of developing the measurement instrument for the collection of subjective data on the potential organisational impacts of the technologies underlying the *ComVantage* project is described in this deliverable, resulting in the final questionnaire, the detailed planning of its distribution, and the optimal platform to be used. This process should result in the effective collection of reliable and valid data from various stakeholders.

The next steps involve the distribution of the questionnaire to prospective respondents, the collection of data, and the analysis of this data. Data analysis will be based on the evaluation framework developed in the first year of the project, in an attempt to quantify the relationships among the various theoretical constructs in the framework, using advanced modelling tools and statistical techniques (e.g., Structural Equation Modelling). Hopefully, the analysis will provide deeper understanding of the possible contribution of the technologies underlying *ComVantage* to the various stakeholders in industrial supply chains.

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7 APPENDIX I: INITIAL INSTRUMENT

Dear respondent,

This questionnaire is part of research conducted within the *ComVantage* project, which is part of the EU's Seventh Framework Programme (FP7) for Research and Technological Development. The purpose of the questionnaire is to examine the effects of information and communication technology (ICT) on organisations. The questionnaire is developed and analysed by a team of researchers from Ben-Gurion University of the Negev.

The questionnaire is intended for managers at all organisational levels. Your anonymity is guaranteed and the data collected via the questionnaire will only be used in an aggregated manner for research purposes. Specific, identified organisational data will not be communicated to any third party. Therefore, you should feel free to answer the different questions in a manner that reflects your true perceptions.

Please complete all five parts of the questionnaire by selecting the most suitable response for each question based on your view of the organisation you work in. Please remember to "submit" your answers at the end of the questionnaire.

Your answers are important to the development of knowledge on the impacts of ICT capabilities in organisations.

Thank you in advance for your participation,

The Research Team, Ben-Gurion University of the Negev

Dr. Lior Fink (finkl@bgu.ac.il), Dr. Sigal Berman (sigalbe@bgu.ac.il), Dr. Orit Raphaeli (oritrap@bgu.ac.il), Dr. Gali Naveh (galin@bgu.ac.il)

Part A

How would you rate the extent of use of the following technologies in your organisation's business processes? (1- not at all, 7 – very high, N/A - not applicable)

	1 - Not at all				Very high - 7		
Mobile applications (applications designed to run on mobile devices, e.g., WhatsApp messenger, Google Maps)							
Semantic web/Linked Data (technologies facilitating exchange of data between independent databases, e.g., health information exchange)							
Cloud computing (platform, infrastructure, or software delivered as a service over the Internet, e.g., Amazon Web Services, iCloud, Salesforce.com)							
Web-based technologies (applications using web infrastructure, e.g., Internet, Intranet)							
Social networks (on-line environments facilitating social relations among people, e.g., Facebook, Twitter, LinkedIn)							
Electronic markets (on-line environments facilitating interactions between buyers and sellers , e.g., e-auctions, e-procurement)							
Virtual meeting tools (applications for on-line meetings, e.g., Skype, Adobe connect, Cisco WebEx)							

Part B

Indicate the extent to which your organisation (1 – not at all, 7 – very high, N/A - not applicable):

	1 - Not at all				Very high - 7		
Shares formal (agreed upon) information with suppliers							
Shares informal information with suppliers							
Communicates future strategic needs to suppliers							
Creates compatible information systems with suppliers							
Collaborates across departments in strategic planning							
Uses integrated databases for internal information sharing							
Shares operational information across departments							
Practices open and trustful communication across the organisation							
Shares formal (agreed upon) information with customers							
Shares informal information sharing with customers							
Communicates customers' future strategic needs throughout the entire supply chain							
Creates compatible information systems with customers							

Part C

Relative to your industry, how would you rate the performance of your organisation over the last three years in the following operational aspects? (1 - very low, 7 – very high, N/A - not applicable)

	1 - Very low				Very high - 7			
Inventory cost								
Production/service cost								
Transportation cost								
Total resource cost								
Product/Service delivery cycle time								
Customer query time								
Purchase order cycle time								
Overall efficiency								
Supplier response time to new demands								
Responsiveness to customer requests								
Delivery lead-time flexibility (adapting lead-time to the dynamic needs of customers)								
Production/service flexibility (time required to add new products/services to existing operations)								
Time-to-market								
Range of products/services offered to customers								
New products/services under development								
Success rate of new products/services								
Percentage of erroneous deliveries								
Product/service quality								
Customer complaints								
Customer satisfaction								
Awareness to sustainability								
Waste generated during production/service operation								
Utility use (e.g., electricity, water)								
Carbon footprint								

Part D

How would you rate the performance of your organisation over the last three years in the following strategic aspects? (1 - very low, 7 – very high, N/A - not applicable)

	1 - Very low				Very high - 7		
Compared to competing products/services, our products offer superior benefits to customers							
Our products/services are unique and are not offered by other companies							
We take great efforts in building a strong brand name, which cannot be easily copied							
Our organisation successfully differentiates itself from others							
Our operation costs are lower than those of our competitors							
Our efficient internal operations have decreased the costs of our products/services							
Our economy of scale enables us to achieve a cost advantage							
Our organisation holds a cost leadership position in the industry							
The financial performance of our organisation has exceeds that of our competitors							
The Return on Assets of our organisation is higher than that of our competitors							
The Return on Sales of our organisation is higher than that of our competitors							
The profitability of our organisation is higher than that of our competitors							

Indicate:

	1 - Standard products				Customised products - 7		
Degree of customisation of your organisation's main products/services (1- mostly standard products with no customisation, 7 - mostly customised products manufactured to customer specifications, N/A – not applicable)							

Indicate the extent to which you agree with the following statements about the business environment of your organisation (1 – strongly disagree, 7 – strongly agree, N/A – not applicable):

	1 - Strongly disagree				Strongly agree - 7		
Customers have numerous, alternative sources of supply							
The business environment is characterised by rapidly changing prices							
The industry is characterised by rapidly growing demand							
The industry is characterised by high competitiveness							

Part E - Background information

Respondent

Please provide information regarding your position in the organisation

A. Job title: _____

B. Function: 1) operations 2) logistics, 3) IT, 4) finance, 5) marketing/sales/customer service,
6) other: _____

C. Management level: 1) junior 2) middle, 3) senior

D. Time with the organisation: 1) less than a year, 2) 1-5 years, 3) more than 5 years

Organisation

Please provide information regarding the organisation

A. Country: [list of countries]

B. Approximately how many employees work in the organisation: 1) Below 20, 2) 20-100, 3) 101-500, 4)
501-1000, 5) over 1000, 6) more than 1.000

C. Industry: 1) Banking/finance, 2) Business services, 3) Communications, 4) Defence, 5) Distribution/retail,
6) Education, 7) Government/municipalities, 8) Health services, 9) Insurance, 10) Logistics, 11)
Manufacturing, 12) Real estate, 13) Technological development, 14) Transportation, 15) Utilities, 16) Other:

D. Geographical reach: 1) Global, 2) EU, 3) Local

E. Role in the supply chain: 1) Raw material manufacturer, 2) Component manufacturer, 3) Final product
manufacturer, 4) Wholesaler, 5) Retailer, 6) Service provider, 7) Other: _____

8 APPENDIX II: PRE-TEST FEEDBACK

Interviewee	Comment	Decision
A	Add BI and Business analytics to questions about technology	Rejected
A	Make internal capability question more similar to questions on supplier/ customer capabilities	Rejected
A	Add direction of improvement in operational performances - cost reduction, quality improvement etc.	Rejected
A	Explain what is carbon footprint	Accepted
A	Standardise scales across questionnaire (all will be "not at all" and "very high" for example)	Rejected
B	Social networks - put LinkedIn first to emphasise business use	Accepted
B	Mobile application - put business examples	Accepted
B	Semantic web - use a more well-known term	Accepted
B	Reorder ICT questions to put more familiar technologies first	Accepted
B	Replace 'databases' with 'systems' in internal capabilities	Accepted
B	Ask about the length of product life cycle in the part about the organisation	Accepted
B	Shorten the question on organisational size to 'size of organisation'	Accepted
B	Question on role in the supply chain- omit the words 'role in the supply chain' and ask about type of organisation	Accepted
B	Add to the scale unknown/NA	Accepted
B	Organisations founded less than 3 years ago can't answer some of the questions	Rejected
C	Mobile applications - give business examples	Accepted
C	Semantic web - give business examples (e.g. - using business indicators for forecasting)	Accepted
C	Social network - add 'Lync' (exchange's social network)	Rejected
C	In relation to what should technology use and performance be evaluated? Competitors? Needs? Market?	Accepted
C	To which e-markets does the question refer to? Internal? External?	Rejected
C	Question about use of cloud - insert 2 items: software as a service, all the rest (platform, infrastructure)	Rejected
C	Add a question about web 2.0	Accepted
C	Give the respondent space to add other technologies being used	Rejected
C	Explain the term 'customer query time'	Accepted
C	Range of products - use alternative word for range (variety?)	Rejected

Interviewee	Comment	Decision
C	Include questions on the environment in a different section	Accepted
C	Add question about the technological level of the organisation	Accepted
C	Consider sending the results to respondents as incentive	Accepted
D	The web based technologies question is unclear	Rejected
D	Add a question on remote access to customer's systems and to the organisation's systems	Accepted
D	Supplier response time to new demand - add 'on average'	Rejected
D	The word 'erroneous' is not clear (in the question about percentage of erroneous deliveries)	Accepted
D	Add definition of 'carbon footprint'	Accepted
D	The question about industry - add engineering	Accepted
D	The question about level of management - add High level management	Rejected
D	Reverse the order of answers in the question about geographical reach	Accepted
D	The question about the role in the supply chain - add to 'raw material' also 'active' (relevant to pharmaceutical)	Rejected
E	Add business example to the question about web 2.0	Accepted
E	Questions about sharing formal information with suppliers and customers is unclear	Rejected
E	'Economy of scale' and 'cost leadership' are not familiar	Rejected
E	Compared to competing products/services, our products offer superior benefits to customers' - add the word services	Accepted
E	Add ROA (Return On Assets) and ROS (Return On Sales) (acronyms)	Accepted
E	Question about information intensiveness is unclear. Perhaps use 'data' instead of information	Accepted
E	Reorganise: put geographical reach after country, put type of organisation before industry	Accepted
E	Use another phrase instead of 'reach' (in the question about geographical reach)	Accepted
E	Add engineering as a function in the organisation	Accepted
E	Add titles to the different sections in the questionnaire to help respondents understand the context of the questions	Accepted
E	Explain what to do if you don't know the answer/ not relevant	Accepted
E	Make the use of singular and plural in the words 'product' and 'service' consistent	Accepted
F	Questions about sharing formal information with suppliers and customers are unclear	Rejected
F	Questions about strategic planning are unsuitable for low management	Rejected

Interviewee	Comment	Decision
F	The question about the use of integrated information systems for internal information sharing is unclear	Rejected
F	The question about the communication of future needs is too broad	Rejected
F	The word 'erroneous' is not clear (in the question about percentage of erroneous deliveries)	Accepted
F	Ask also about the city (on top of country) of the respondent (due to big differences between small and large cities)	Rejected
F	Use another phrase instead of 'reach' (in the question about geographical reach)	Accepted
F	7 point scales are too broad	Rejected
G	Question about industry - combine insurance with banking/finance, add shipping to transportation	Accepted

9 APPENDIX III: FINAL INSTRUMENT

Dear manager,

This questionnaire is part of research conducted within the *ComVantage* (Collaborative Manufacturing Network for Competitive Advantage) project, which is part of the EU's Seventh Framework Programme (FP7) for Research and Technological Development. The purpose of the questionnaire is to examine the effects of information and communication technology (ICT) on organisations. The data collected by the questionnaire will be analysed by a team of researchers from Ben-Gurion University.

The questionnaire is intended for managers at all organisational levels. Your anonymity is guaranteed and the data collected via the questionnaire will only be used in an aggregated manner for research purposes. Specific organisational data will not be communicated to any third party. Therefore, feel free to answer the different questions in a manner that reflects your true perceptions.

Please complete all six parts of the questionnaire by selecting the most suitable response for each question based on your view of the organisation you work in. Completing the questionnaire should take about 10-15 minutes.

If you would like to receive an executive summary of the results of this survey, enter your email address through the link provided after you complete the survey. Entering the email address is optional. The address will not be associated with your responses in any way and it will be used only for emailing you the results and for allowing us to contact you should you win a prize.

Three of those who will complete the survey, chosen randomly, will receive vouchers of \$100 to be used at Amazon.

Your answers are important to the development of knowledge on the impacts of ICT capabilities in organisations.

Thank you in advance for your cooperation,

The *ComVantage* Research Team, Ben-Gurion University of the Negev

Dr. Lior Fink (finkl@bgu.ac.il), Dr. Sigal Berman (sigalbe@bgu.ac.il), Dr. Orit Raphaeli (oritrap@bgu.ac.il), Dr. Gali Naveh (galin@bgu.ac.il)

Part A - ICT use in the organisation

How would you rate the extent of use of the following technologies in your organisation's business processes? (1- not at all, 7 – very high, N/A - not applicable)

	1 - Not at all						Very high - 7					
Web-based technologies (applications using web infrastructure, e.g., Internet, Intranet)												
Social networks (on-line environments facilitating social relations among people, e.g., LinkedIn, Facebook, Twitter)												
Electronic markets (on-line environments facilitating interactions between buyers and sellers , e.g., e-auctions, e-procurement)												
Virtual meeting tools (applications for on-line meetings, e.g., Skype, Adobe connect, Cisco WebEx)												
Mobile applications (applications designed to run on mobile devices, e.g., Email, WhatsApp messenger, Google Maps)												
Web 2.0 technology (applications that support the creation of user-generated content in a virtual community, e.g., Wikipedia, crowd computing, blogs)												
Web 3.0/Semantic web/Linked Data (web of machine-readable pages, e.g. DBpedia)												
Cloud computing (platform, infrastructure, or software delivered as a service over the Internet, e.g., Amazon Web Services, iCloud, Salesforce.com)												

Part B - Collaboration with suppliers, customers, and within the organisation

Indicate the extent to which your organisation (1 – not at all, 7 – very high, N/A - not applicable):

	1 - Not at all						Very high - 7					
Shares formal (agreed upon) information with suppliers												
Shares informal information with suppliers												
Communicates future strategic needs to suppliers												
Creates compatible information systems with suppliers												
Is able to access the information systems of suppliers												
Collaborates across departments in strategic planning												
Uses integrated information systems for internal information sharing												
Shares operational information across departments												
Practices open and trustful communication across the organisation												
Shares formal (agreed upon) information with customers												
Shares informal information with customers												

	1 - Not at all				Very high - 7			
Understands the future strategic needs of customers								
Creates compatible information systems with customers								
Is able to access the information systems of customers								

Part C - Operational performance

Relative to your industry, how would you rate various operational aspects of your organisation over the last three years? (1 - very low, 7 – very high, N/A - not applicable)

	1 - Very low				Very high - 7			
Inventory cost								
Production/service cost								
Transportation cost								
Total resource cost								
Product/service delivery cycle time								
Customer query time (time to respond to a customer enquiry with the required information)								
Purchase order cycle time								
Overall efficiency								
Supplier response time to new demands								
Responsiveness to customer requests								
Delivery lead-time flexibility (adapting lead-time to the dynamic needs of customers)								
Production/service flexibility (time required to add new products/services to existing operations)								
Time-to-market								
Range of products/services offered to customers								
New products/services under development								
Success rate of new products/services								
Percentage of mistaken deliveries								
Product/service quality								
Customer complaints								
Customer satisfaction								
Awareness to environmental sustainability								
Waste generated during production/service operations								
Utility use (e.g., electricity, water)								
Carbon footprint (greenhouse gas emissions caused by the organisation)								

Part D - Strategic performance

How would you rate the performance of your organisation over the last three years in the following strategic aspects? (1 - very low, 7 – very high, N/A - not applicable)

	1 - Very low				Very high - 7		
Compared to competing products/services, our products/services offer superior benefits to customers							
Our products/services are unique and are not offered by other companies							
We take great efforts in building a strong brand name, which cannot be easily copied							
Our organisation successfully differentiates itself from others							
Our operation costs are lower than those of our competitors							
Our efficient internal operations have reduced the costs of our products/services							
Our economies of scale (lower cost per unit due to a larger amount of units) enable us to achieve a cost advantage							
Our organisation holds a cost leadership position in the industry							
The financial performance of our organisation exceeds that of our competitors							
The return on assets (ROA) of our organisation is higher than that of our competitors							
The return on sales (ROS) of our organisation is higher than that of our competitors							
The profitability of our organisation is higher than that of our competitors							

Part E - Industrial environment

Please indicate:

	1 - Standard products				Customised products - 7		
Degree of customisation of your organisation's main products/services (1- mostly standard products with no customisation, 7 - mostly customised products manufactured to customer specifications, N/A – not applicable)							

	1 - Very short				Very long - 7		
The life cycle of your organisation's main products/services (1 - very short, 7 - very long, N/A – not applicable)							

	1 – Not at all				Very high - 7		
Extent to which the products/services and production processes in your organisation involve intensive data processing? (1 – not at all, 7 – very high, N/A – not applicable)							

Indicate the extent to which you agree with the following statements about the business environment of your organisation (1 – strongly disagree, 7 – strongly agree, N/A – not applicable):

	1 - Strongly disagree				Strongly agree - 7		
Customers have numerous, alternative sources of supply							
The business environment is characterised by rapidly changing prices							
The industry is characterised by rapidly growing demand							
The industry is characterised by high competitiveness							

Part F - Background information

Your position:

Please provide information about your position in the organisation

- A. Job title _____ :
- B. Function: 1) Operations 2) Logistics, 3) IT, 4) Finance, 5) Marketing/sales/customer service 6) Engineering, 7) Other _____ :
- C. Management level: 1) Junior 2) Middle, 3) Senior
- D. Time with the organisation: 1) Less than a year, 2) 1-5 years, 3) More than 5 years

Your organisation:

Please provide information about your organisation

- A. Country: [list of countries]
- B. We are active (geographical reach): 1) Locally, 2) Across Europe, 3) Around the globe
- C. Number of employees in the organisation: 1) Below 20, 2) 20-100, 3) 101-500, 4) 501-1000, 5) Over 1000
- D. Type of organisation: 1) Raw material manufacturer, 2) Component manufacturer, 3) Final product manufacturer, 4) Wholesaler, 5) Retailer, 6) Service provider, 7) Other _____ :
- E. Industry: 1) Banking/finance/insurance, 2) Business services, 3) Communications, 4) Defence, 5) Distribution/retail, 6) Education, 7) Government/municipalities, 8) Health services, 9) Logistics, 10) Manufacturing, 11) Real estate, 12) Technological development, 13) Transportation/ shipping, 14) Utilities, 15) Engineering, 16) Other: _____

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