CENTER FOR AUTOMOTIVE RESEARCH

ENERGY, ENVIRONMENT, & TRANSPORTATION DIVISION OF ALTARUM

Computer Assisted Collaboration in the Automotive Industry:

What Are the Complex Problems and How Are Decisions Made?

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What Are the Complex Problems and how are Decisions Made?

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Table of Contents

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List of Tables

List of Figures

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SUMMARY

Market forces are driving the automotive industry toward shorter design times, shorter order fulfillment cycles, and fewer labor hours in final assembly. To cope with these changes, automotive supply chains are becoming more diverse, and their information environments more complex. Our research program has been studying how automotive supply chains are adapting to these realities. Our view is that the most robust, adaptable, and powerful information exchange systems will prove to be those which combine automated processing for activities that are routine and predictable, with transactions that are *assisted* by information technology, but which are, ultimately, human activities.

Here we summarize the beginnings of our exploration of this belief. We report on a small-scale interview project that we hope will prove valuable in its own right, but whose main purpose was to set the stage for larger, more in-depth research. The intent of this research was to identify events whose management requires both heavy doses of human interaction, *and* rich collaboration among many different functions within a company. It is our belief that these events will prove the most desirable targets for improving enterprise functioning by improving information flow and information access.

Interviews were conducted with 12 people in five companies. Respondents were asked to identify events that fit our criteria as being heavy in need for both human interaction, and cross-functional collaboration. Sixteen scenarios were identified, fourteen of which could be placed at various stages of the product development life cycle, and two of which were cross-cutting issues. Data analysis proceeded through two stages: 1) categorize patterns of information flow in each scenario, and 2) identify the nature of problems within each pattern.

Five "information flow" patterns emerged: 1) integration of diverse input into a single format 2) transmission in different formats of information that was generated in a single format, 3) synthesis of diverse information to make a decision, 4) identification and retrieval of information from far-flung sources within a company, and 5) restricted information flow into the organization from outside sources. Once these patterns were mapped to the information scenarios, the next step explored *why* each information management scenario was problematic. Five types of problems emerged: 1) legacy systems, 2) dollar cost, 3) complexity of cross-linked problems, 4) uncontrolled input from the outside, and 5) reliance on human knowledge because data were not systematically captured.

Given our focus on computer-assisted decision-making, eleven of the information management scenarios warranted further analysis. Three conclusions emerged from this exercise. First, while most of the scenarios fell at well defined points on the product development life cycle, the attendant information flow problems were spread across the life cycle. For instance, early-stage design engineers may be unable to identify, access, or use potentially relevant information which emerged from warranty and repair activities. Second, technical, as opposed to business data, posed the greatest problems. However, this observation should be tempered by the makeup of the sample, which was comprised of people with operational, as opposed to long term strategic, perspectives. Finally, there is a lot of information flow of technical data across organizational boundaries. However problematic internal information management and collaboration processes may be, these activities are at least bound by a single organizational culture, and by whatever consistency a corporation is able to impose on its divisions and personnel. As a result, these activities are relatively amenable to automation, or at least to a combination of partial automation and a high degree of routinization. When organizational boundaries are crossed, the internal discipline of a single organization is replaced with

contractual arrangements and informal ties of trust that may or may not have developed over the years among personnel in different companies. Such cross-company transactions are among the most complex and unpredictable in the business world, and hence, are the least amenable to simple, IT-based solutions.

ABOUT THE AUTHORS

Jonathan A. Morell (Jonny) is an organizational psychologist with special expertise in measuring and evaluating the products, services, and activities that constitute electronic business. He has extensive experience helping large and small companies implement, and derive benefit from, information technology. In addition to work with individual companies, he has worked with industrial sectors, supply chains, and the standards community.

Jonny has published widely on how information technology affects work. He serves as Editor-in-Chief of the journal Evaluation and Program Planning, and is on the editorial board of two journals that deal with the business consequences of information technology, the International Journal of Electronic Business, and the International Journal of Services Technology Management. He is active in the American Evaluation Association, winner of the Association's Distinguished Service Award, a Fellow of the Society for Community Research and Action, and a member of the National Advisory Committee for the Robert Wood Johnson's program in evaluating E-health technologies.

Jonny has a Ph.D. in Psychology from Northwestern University. Prior to joining Altarum, he worked as a Professor at Hahnemann University, and for Martin Marietta Energy Systems as a staff member at the Oak Ridge National Laboratory. His present position is Senior Policy Analyst in Altarum's Enterprise Solutions Division.

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Bernard participated in the production of The Contribution of the Auto Industry to the U.S. Economy. He is co-editor of the *Program Timing Directories*, maintains CAR's information resources, and remains active in work on the Michigan Automotive Partnership (MAP). He recently contributed data coordination for and co-authored a report entitled *E-readiness of the Automotive Supply Chain: Just How Wired is the Supplier Sector?,* as well contributing his efforts to other studies investigating the role of information technology in the automotive industry. Bernard is a member of the Society of Automotive Engineers and authors freelance articles and a column on the automotive industry.

David J. Andrea earned a B.S. degree in business economics from Miami University (Ohio) and an M.B.A. from the University of Michigan. Previous to his position at CAR, Mr. Andrea was chief economist with CSM Worldwide, a Michigan-based automotive forecasting and consulting firm. Prior to that, he served as an equity investment analyst with Roney & Co. (now Raymond James), a Detroit-based, regional investment bank. In that position he followed automotive manufacturers and suppliers. Between 1994 and 1996, Mr. Andrea was director of forecasting with AutoPacific, Inc., providing economic and sales analysis, along with market and product technology trend analysis. Prior to AutoPacific, he worked for eight years with the University of Michigan's Office for the Study of Automotive Transportation, leaving as an Assistant Research Scientist. He is also a Vice Chairman of the Global Leadership Conference and member of the finance committee for the Detroit Section of the Society of Automotive Engineers; the advisory board to the Economic Club of Detroit; and member of the National Association for Business Economics and the Detroit Association for Business Economics.

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BACKGROUND AND SCOPE

Market forces are driving the automotive industry toward shorter design times, shorter order fulfillment cycles, and fewer labor hours in final assembly. To cope with these changes, automotive supply chains are becoming more diverse, and their information environments more complex. Our research program has been studying how automotive supply chains are adapting to these realities. Much of the attention given to these adaptations is focused on transactions that are amenable to automation through improved data exchange. Examples include order scheduling, logistics tracking, and engineering change notifications. Discussion of these processes seems to be based on the implicit assumption that if only the data were standardized enough, and if only IT systems were integrated enough, and if only business processes were defined well enough, then information could flow smoothly, unperturbed by human intervention. The vision is akin to the "lights-out factory," that image of interacting mechanical devices that could produce product with minimal human labor.

However, the internal complexity of real systems, combined with the environmental uncertainty in which they reside, make "minds-off" systems just as unrealistic as their "hands-off" analogues. Our view is that the most robust, adaptable, and powerful information exchange systems will prove to be those which combine automated processing for the activities that are routine and predictable, with transactions that are *assisted* by information technology, but which are ultimately human activities. This report summarizes the beginnings of our exploration of this belief. It is a small-scale interview project that we hope will prove valuable in its own right, but whose main purpose is to set the stage for larger, more in-depth research.

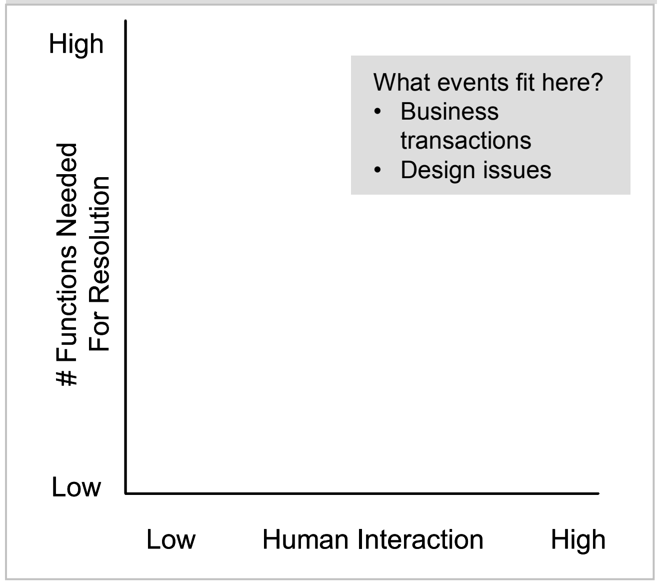
FRAMEWORK TO IDENTIFY CRITICAL EVENTS

One way to categorize communication between trading partners is on a scale of "need for human interaction." At one end of the "interaction" scale are activities that can be fully embedded in business rules and completely automated. An example is long term contracting to maintain preset inventory stocking levels. At the opposite end of the scale are activities where the components, and the processes, of the communication are embedded in the communication itself and cannot be well specified. An example of this is contract negotiation. Other examples include creating cost and production schedules, and determining the consequences of an engineering change notice.

A second way to categorize interaction is by its complexity. Because communication "complexity" is in itself complex, we use as a rough proxy the number of functions within a company that are required for resolution of an issue. At the "low" end of the continuum are cases where two people are sufficient to resolve an issue. An example is a query about newly set price breaks at different quantities. An example at the "high" end of the complexity scale—involving many persons and multiple functions—is determining production schedules, an activity that requires input from manufacturing, plant maintenance, human resources, finance, and sales.

Combining the two scales produces the graph shown in Figure 1. The intent of this research was to identify events that fall in the upper right hand quadrant, i.e. events that require heavy interaction among many different functions. It is our belief that these events, with improved information flow, will have the greatest contribution to improving automotive supply chain interaction.

Figure 1: What complex OEM/Supplier Transactions Require Human Participation?



METHODOLOGY

Semi-structured interviews were conducted with 12 people in five companies. Descriptions of these companies, and descriptive titles of the people interviewed, appear in Table 1. This was a sample of convenience. Our original intention was to recruit respondents who could speak across the entire product life cycle, and about events that involved interaction both within their companies and between their companies and their trading partners. Constraints on time and budget, however, produced a much less systematic representation. The primary limitation on the sample is that none of the respondents had a job requiring a long-term strategic view. In one way or another, they all had an operational focus. To anticipate later discussion, this limitation may have affected our conclusions. Still, we believe the sample was adequate for our fundamental purpose: to understand the issues relevant to creating robust, adaptable, and powerful information exchange systems.

Table 1: Interviews Conducted

Company	**Descriptive Titles of Interviewees**
Global First Tier Component Supplier	➢ Director, eCommerce ➢ eCommerce, Engineering ➢ eCommerce, Manufacturing
Discrete Component First Tier Component Supplier	➢ Manager, Manufacturing Process Support Systems for Worldwide Information Technology
Mass Market Vehicle Manufacturer and Component Producer	➢ Business Model Analyst ➢ Product Design Engineer, Advanced Vehicle Technology
Global Vehicle Manufacturer and Component Producer	➢ Director, Truck and Field Support Systems ➢ Director, IT Projects Office ➢ Manager, Systems
Process-Dominated First Tier Component Manufacturer	➢ CAD Design Team Leader

Respondents were asked to consider the graph in Figure 1, and then to identify events within their work lives that fit the shaded area. With respect to each event, respondents were asked to answer the questions that appear in Table 2.

Table 2: Questions to Structure the Interview
Description
1. What is the issue or problem that is the subject of the interaction?
2. Where does this event fit in the product life cycle?
3. How frequently does this event occur?
Solutions
4. What makes this event complex and in need of human resolution?
5. Why hasn't automation played a larger role in dealing with these kinds of situations?
6. Relative to the solutions you would like to see, how well do you deal with these events?
Consequences
7. In terms of cost, quality and time, how important is it to deal with this issue successfully?
8. If you could resolve this issue better, are there other problems that would also be helped?
Who is involved in problem resolution?
9. Who are the key decision makers?
10. What major functions *within* your company are required for dealing with these events?
11. What major functions in companies *outside* your own are required for dealing with these events?
12. Are there groups you would like to get involved in dealing with these issues, but which you usually do not consult?

FINDINGS

Interview responses produced sixteen events, fourteen of which can be placed at various stages of the product development life cycle, and two of which are cross-cutting issues. The number of cases in each category is shown in Table 3. Summaries of each information management scenario are provided in Appendix 1. Data analysis proceeded through two stages: 1) categorize pattern of information flow scenarios 2) assess problematic patterns of information flow.

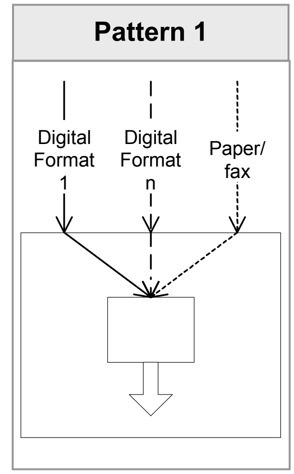
Table 3: Scenario Classification

Life Cycle Stage	**Cases**
Product design	4
Order entry / processing	3
Production scheduling	2
Production process improv	1
Outbound logistics	1
Warranty	3
Cross-Cutting Issues	
Knowledge transfer	1
System proliferation	1

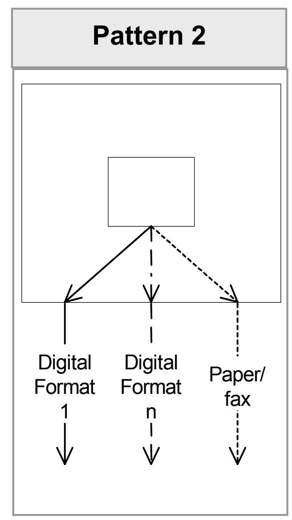
Stage 1: Determine Patterns of Information Flow

Content analysis of the scenarios described by respondents yields five distinct patterns of information flow.

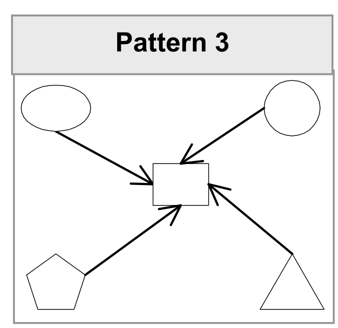
INFORMATION PATTERN 1: Diverse input formats must be expressed in a single common format. In this case a company has to resolve different formats in order to deal with a single business process. Examples include different ways of processing incoming orders (e.g. fax, EDI, email), or transforming different CAD formats into a company standard.



INFORMATION PATTERN 2: Multiple outputs of the same information to different sources. This is the output side of Pattern 1. Here, a company has to generate multiple outputs of the same or similar information. Sometimes the information is the same format, but goes to different sources, as when a company has to send the same information to its customer and its customer's logistics provider. Sometimes, there are different formats, as well as different sources.

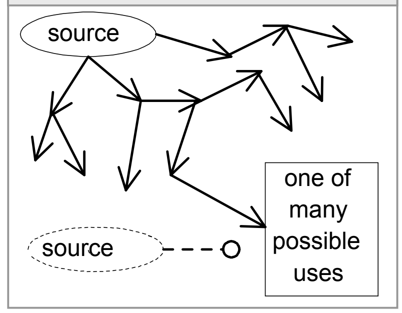


INFORMATION MANAGEMENT PATTERN 3: Integrating diverse information from heterogeneous sources to make a decision. In this case the problem is to find information from multiple sources to bring to bear on a problem. Most production scheduling and warranty examples fit here.



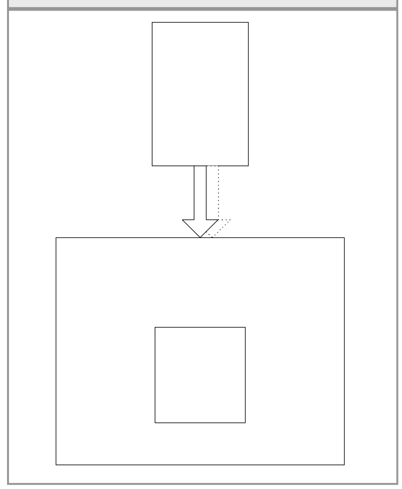
INFORMATION MANAGEMENT PATTERN 4: Information availability. One aspect of the problem is that information generated in one location must be retrieved for a use that is far removed from the time and system that originally generated the information. A second element is that needed information may not be available at all. It is hard to know what information the company has generated, or where it is. Even if one knew, the information may not be in a form that is accessible or usable for the work at hand.

Pattern 4: Information Availability



INFORMATION MANAGEMENT PATTERN 5: Information flow into the organization is restricted or unreliable. In this case information is generated outside of a company, but only some of it gets into the organization. As an example, information collected by a dealer, which might be useful for warranty analysis, is not sent to the manufacturer because the information is not necessary for parts ordering or payment.

Pattern 5: Information Flow into Organization Restricted or Unreliable



Once the patterns of information flow were described, we determined which pattern applied to each of the sixteen information scenarios collected during the interviews. This information is summarized in Table 4.

Table 4: Information Management Themes

	Multiple input to single format	Multiple outputs, single format	Diverse information for decisions	Information Availability	Restricted information from outside
Product Design					
Product Design Scenario 1: Coordination not tight among suppliers of related modules. Implications of design change hard to track through whole system.	•				
Product Design Scenario 2: ECN tracking problem compounded within OEMs that have different systems across the engineering groups.	•				
Product Design Scenario 3: Pre-production components (hardware and software) tested in prototype. Lots of component swapping. Version control is a problem.				•	
Product Design Scenario 4: ECN tracking through OEM legacy systems. Crucial to follow path of all impacted components and related software. Industry is retiring many experienced engineers.				•	
Order Entry/Processing					
Order Entry/Processing Scenario 1: Incoming orders in many non-standard channels: fax, paper, EDI, web. Each system costs $. Top 5 customers are digital, rest are not.	•				
Order Entry/Processing Scenario 2: Within each channel, format not consistent. Different divisions have separate 830/862 combination, and a separate log in.	•				
Order Entry/Processing Scenario 3: EDI orders always checked manually because customer "plays games" with their cumulatives, or resets to 0 for unexplained reasons.					•
Production Scheduling					
Production Scheduling Scenario 1: Lots of linked considerations for vehicles – suppliers, labor, dealer relations, product make up, finance, inventory, sales. Data not readily available, many iterations needed.			•	•	
Production Scheduling Scenario 2: Complexity high, can never be fully automated. Issues include delivery dates, optimizing lines, capacity, etc.			•	•	

Table 4: Information Management Themes (concluded)	Multiple input to single format	Multiple outputs, single format	Diverse information for decisions	Information Availability	Restricted information from outside
Production Process Improvement					
Production Process Improvement Scenario 1: Hard to transfer process across sites. Spotty success. Lots of opinions to explain outcome. Heavy need for personal knowledge.			•	•	
Outbound Logistics					
Outbound Logistics Scenario 1: “A” has customer “X”, who ships via “Y”, “QUOTES, NOT”, ” X” requires EDI, “Y” the Web. More responsibility for “A” who must query system about trucking.		•			
Warranty					
Warranty Scenario 1: Who is responsible for what? Complicated -- OEM/supplier warranty pass through, extended/-customized warranties. Customer, dealer, company, suppliers involved.			•		•
Warranty Scenario 2: Information difficult to track, many variables in cause and effect analysis. With non-catastrophic failure, hard to track and analyze. Restricted info from dealer to do failure analysis.				•	•
Warranty Scenario 3: Warranty data to help with design. Data may be reported only monthly, or only if queried. Engineering may not know what is available, or have the time to retrieve it.					•
Knowledge transfer					
Knowledge transfer Scenario 1: Knowledge transfer problem with R&D practice				•	
System Proliferation					
System Proliferation Scenario 1: Number of EB systems is increasing, and this has real consequences for people and money. Worried that pattern will multiply across customer base.	•	•			

Stage 2: Determine Reasons Why Information Flow is Problematic

The next step in the analysis was to determine *why* each information management scenario identified by respondents was problematic. Categories derived from this analysis were: 1) legacy, 2) money, 3) complex problem with cross-linked components, 4) uncontrolled input from the environment, and 5) data not captured/excessive reliance on personal knowledge. A fuller explanation of these labels appears in Table 5.

Table 5: Explanation of Problem Labels

Problem	Explanation of Label
Legacy	Time, effort, disruption, cost, risk involved in changing entrenched information systems
Money	Primary difficulty is cost, as opposed to "legacy", where cost is only part of many reasons to shun change.
Complex problem / cross linked components	Cases where many variables are at play, and a change in any one can change the overall decision vector.
Uncontrolled input from the outside	Frequent revision is necessary because important inputs have high, and uncontrolled, variability.
Data not captured / reliance on human knowledge	Information not accessible/because IT systems contain it in unusable form, or because it only exists in peoples' heads.

Applying these reasons to each information management scenario yielded Table 6. (Scenario numbers correspond to scenarios in Table 4.)

Table 6: Reasons Why Information Management is Difficult

	Legacy	Money	Complex problem / cross linked components	Uncontrolled input from outside	Data not captured / reliance on human knowledge
Product Design Scenario 1				•	
Product Design Scenario 2	•				
Product Design Scenario 3					•
Product Design Scenario 4					•
Order Entry/Processing Scenario 1				•	
Order Entry/Processing Scenario 2				•	
Order Entry/Processing Scenario 3		•		•	
Production Scheduling Scenario 1	•		•		
Production Scheduling Scenario 2	•		•		
Production Process Improvement Scenario 1					•
Outbound Logistics Scenario 1					•
Warranty Scenario 1				•	
Warranty Scenario 2				•	•
Warranty Scenario 3	•				
Knowledge Transfer Scenario 1			•		•
Systems Proliferation Scenario 1	•				

Given our focus on computer-assisted decision-making, eleven of the information management scenarios warranted further detailed analysis. These results are summarized in Table 7.

Table 7: Data Flow Specifics	
Product design	
Trigger	Failure of test validation at OEM or supplier
Relevant functions	OEM Engineering, purchasing, supplier engineering
Systems / information domains	Product specs, performance tests, requirements, approved vendors in engineering and purchasing databases at both OEM and suppliers
Data – ease of access	Lots of human to machine interaction, system interoperability is very low. High uncertainty about which information is relevant
Data — type	Product
Trigger	ECN is received
Relevant functions	Engineering, purchasing, manufacturing, suppliers, parts and service
Systems / information domains	Spec, performance, testing requirements, material specs, approved vendors in Engineering and purchasing databases at both OEM and suppliers, parts and service
Data – ease of access	Information divided among a number of players, is not real-time, possible political implications
Data – type	Product
Trigger	Failure of an established testing protocol
Relevant functions	Engineering release process – OEM and supplier
Systems / information domains	Database of components used during testing, release of what should have been on the car
Data – ease of access	Release information is readily available but finding out which parts were tested is hard. Even harder when using prototype parts from diverse suppliers
Data – type	Product
Trigger	Discovery of a component flaw triggers a manufacturing issue notice
Relevant functions	Purchasing, engineering, manufacturing, suppliers
Systems / information domains	Purchasing, engineering, manufacturing, suppliers
Data – ease of access	Individual legacy systems are not integrated, requiring multiple hand entry. Sometimes must include suppliers.
Data – type	Product

Table 7: Data Flow Specifics (continued)	
Production scheduling	
Trigger	Production Scheduling Deadline (PSD)
Relevant functions	Suppliers, Labor, dealer relationships, component spec, finance, inventory, sales, production
Systems / information domains	Suppliers, Labor, dealer relationships, component spec, finance, inventory, sales, production
Data – ease of access	Data available, but must be drawn from many sources.
Data – type	Business
Trigger	Need for a production schedule
Relevant functions	Sales, production, engineering, preventive maintenance
Systems / information domains	Sales, production, engineering, preventive maintenance
Data – ease of access	Only stovepipe data available.
Data – type	Business
Production process improvement	
Trigger	Transfer of production process from one site to another
Relevant functions	Highly distributed across various functions
Systems / information domains	Highly distributed, with much data in peoples' heads
Data – ease of access	Very hard. Much relevant information only in people's heads.
Data – type	Manufacturing process
Warranty	
Trigger	Whether to cover, when can't be resolved at the local or regional level
Relevant functions	Depending on specifics could include any or all: purchasing, engineering at OEM, engineering at supplier, possibly
Systems / information domains	Same

Table 7: Data Flow Specifics (concluded)	
Production scheduling	
Data – ease of access	Useful data from dealers often not available. Other data available but stove piped. Company data available if engineers willing to hunt for it.
Data – type	Business
Trigger	Quality assessment
Relevant functions	Depending on specifics could include any or all: purchasing, engineering at OEM, engineering at supplier, possibly manufacturing sales, dealer, customer
Systems / information domains	High diversity – context dependent
Data – ease of access	Difficult
Data – type	Product
Trigger	Improve design
Relevant functions	Depending on specifics could include any or all: purchasing, engineering at OEM, engineering at supplier, possibly manufacturing sales, dealer, customer
Systems / information domains	High Diversity – Context Dependent
Data – ease of access	Difficult
Data – type	Product
Knowledge transfer	
Trigger	Innovation in R&D or successful process in a particular plant
Relevant functions	Very context specific to innovation
Systems / information domains	Equally context specific.
Data – ease of access	Heavy reliance on personal knowledge and expertise
Data – type	Product, process

CONCLUSIONS

Several themes emerge from the findings, and from Table 7 in particular. First, nine of the 11 scenarios fall at well defined places along the product development life cycle—four at product development, two at the production stage, and three at post-sales. Of the remaining two, one might be considered part of "production" as it relates to manufacturing process improvement (which, to be an issue for a company, presupposes that something is in production). Only one is truly not easily placed on the product life cycle, i.e. the transfer of knowledge from R&D into practice. While "product life cycle" does seem like a useful way to categorize cases of computer assisted collaboration, it is important to differentiate the role of information from activities using that information. While *activities* fall onto the product life cycle, much *information* spans the life cycle. For instance, product design processes involve different groups and different people than warranty analysis. These activities are distinct phases in the product life cycle. But the data used during these activities may span the life cycle, as when the design engineers need post-sales quality data to factor into early-stage design decisions.

Second, technical data (as opposed to business data), is the major information management problem. The eleven scenarios yielded twelve "predominant data types." (One scenario contained two.) Of these, only three had a primary focus on business data. All the others dealt with product data (7 cases), or manufacturing process (2 cases). This observation needs to be tempered by the makeup of the sample, which was comprised of people with operational, as opposed to long term strategic, perspectives. The strategic view may require types of information, and patterns of collaboration, that were not captured in the few interviews we conducted.

Finally, there is a lot of information flow of technical data across organizational boundaries. Eight of the eleven cases involve (or potentially involve) coordination between an OEM and suppliers and/or dealers. However difficult internal information management and collaboration processes may be, at least these activities are bound by a single organizational culture, and by whatever consistency a corporation is able to impose on its divisions and personnel. When organizational boundaries are crossed, these bonds are replaced with contractual arrangements and informal ties of trust that may or may not have developed over the years among personnel in different companies.

APPENDIX 1: INFORMATION MANAGEMENT SCENARIOS

Life Cycle Stage	Summary of Information Management Scenario
Product Design Scenario 1	Programs are often not bid out by OEM purchasing groups as one integrated package, but as several individual modules. May or may not be strong coordination among the sub-tier suppliers. Often no strong mechanism to coordinate, for example, ECNs through the supply chain of impacted components because each sub-tier supplier is using their own tracking system.
Product Design Scenario 2	ECN tracking problem compounded within OEMs that have several different legacy systems across the engineering groups. These systems often times do not have common protocols and require manual matching or re-entry of data.
Product Design Scenario 3	Pre-production activities, individual components and integrated systems are being tested in prototype. Individual components may be swapped out for testing or updated due to an ECN. Often times, only handwritten logs are kept requiring engineers to write down every change. With so many potential variables in a prototype, often times an engineer will encounter a problem but not accurately know the design levels of all components and software installed.
Product Design Scenario 4	Tracking of an ECN through manufacturer legacy systems. Crucial to follow path of all impacted components and related software. Industry is retiring many experienced engineers, losing the experience that knew the components, functional areas, and individual engineers that would be impacted by a specific ECN. Significant opportunity for automated software that will coordinate these triggering events. Following paper trail particularly important in long trails of ECNs that traverse several functional areas and hierarchical levels. Software may allow decision making to breakthrough political barriers by creating new operating standards and protocols.
Order Entry /Processing Scenario 1	Incoming orders use a multitude of non-standard methods, fax, paper, EDI, web. System proliferation has real consequences for time and money because each system costs $. Top 5 are digital but for most of the rest are not.
Order Entry /Processing Scenario 2	Within a single method, format is not consistent. Example: We ship to different divisions. Each uses a different 830/862 combination, and each has a separate log in.
Order Entry /Processing Scenario 3	Ordering information is always checked by eyeball. No unquestioned pass through of data from system to system. This does not happen with fax and paper, but it does for EDI. Why? It has to do with the customers involved, who play games with their cumulatives. Not a computer problem so much as a way they do things. Then you get companies like “X”, which over a weekend for whatever reason will reset their cumulatives to 0.
Production Scheduling Scenario 1	Lots of considerations in vehicle production – suppliers, labor, dealer relations, product make up, finance, inventory, sales. Cross linked issues, Data not available, need for iterations.
Production Scheduling Scenario 2	High complexity can never be fully automated. Issues include delivery dates, optimizing lines, capacity, etc. Relevant groups: customers, production, engineering, sales, others. Planners make schedule on a daily or weekly basis. Lots of personal experience. Need systems to get data that cuts across domain expertise. E.g. PM implications of splitting a production run.
Production Process Improvement Scenario 1	Production transfers process from one site to another. Hard to transfer a practice. Sometimes works and sometimes does not. Lots of opinions of why it works or does not, hard to document the engineering process. Lots of personal knowledge needed. People don’t like to talk about failure. Can’t get data on dynamics. Even if they knew, it would be hard to teach others. Good project management is the key. Institutional memory a problem.
Outbound Logistics Scenario 1	Company A with OEM customer X. X uses third party logistics company “Y” for shipping. X sends EDI to Y. Y has a web interface to A. A sends ASNs to X and Y. With X, A’s responsibility has also increased. Have to check on line information to decide what truck shipments to use.

Life Cycle Stage	Summary of Inromation Management Scenario
Warranty Scenario 1	Becomes a regional or corporate issue if it involves substantial cost, safety, product reputation or is an issue a customer and dealer can't resolve. Complicated OEM/supplier warranty pass through, extended and customized warranties. Groups involved: customer, dealer, company, sometimes the supplier. Problem of restricted info from dealer. After customer is satisfied, a failure analysis is done. E.g. use of vehicle, mfg. process, component failure, maintenance, dealership process. Would like to predict, not react.
Warranty Scenario 2	Warranty information difficult to track because of the diverse number of variables going into a cause and effect analysis. In both pre-production testing and post-sale service, there are wide variations in the problem definition, inaccurate labeling of issues, and actual physical parts to test. Parts that have a catastrophic failure are easy to catalog, track, and analyze. Parts that fail to perform to specification or consumer expectation are more difficult to capture data on but tell an important story. This is becoming more and more important as suppliers have warranty sharing agreements with the manufacturers.
Warranty Scenario 3	Warranty data may be reported out of a system only monthly. Other systems deliver information only if queried. Often engineering community does not seek this input due to lack of understanding of availability, time, or resource constraints. Engineers would like a system integrated to deliver warranty information on parts as the engineer is working on the specific drawings or specifications.
BP – Cross Cutting Issues	
Knowledge Transfer Scenario 1	As with production process improvement at "X", there is a knowledge transfer problem with R&D→ practice.