SUMMARY OF THE FOURTH ANNUAL WORKSHOP AND OPEN SYMPOSIUM ON SERVICE SYSTEMS SCIENCE AT TOKYO INSTITUTE OF TECHNOLOGY

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From March 6 through March 8, 2011, **Kyoichi Kijima**, Ph.D., Professor of Decision Systems Science, hosted the Fourth Annual Workshop and Open Symposium on Service Systems Science, sponsored by Research Institute of Science and Technology for Society (RISTEX), Japan Science and Technology (JST), at the Tokyo Institute of Technology. The purpose of the workshop and symposium was to bring together leading researchers, educators, and practitioners from North America, Europe, Asia, and Japan to share experiences and exchange expertise related to service science, management, and engineering (SSME). Through participation in the workshop, these leaders clarified important concepts, practices, and challenges in a collaborative venue using a systems science perspective. At the open symposium, distinguished speakers shared their experience from the frontiers of the field and their visions for the future of service systems science. The three days concluded with a panel discussion about state-of-the art approaches to advance the field of service systems science. This paper presents a summary of the workshop proceedings and shares ideas about next steps in the development of the field of service systems science.

One of the goals of the workshop and symposium was to induce different perspectives from Subject Matter Experts (SMEs) in the field of service systems science. Distinguished speakers included **Foong Sew Bun**, IBM Distinguished Engineer and Chief Technology Officer (Singapore); **Louis E. Freund**, Ph.D., Charles W. Davidson Professor of Industrial and Systems Engineering at San Jose State University (California, USA); **Colin Harrison**, Ph.D., Distinguished Engineer at IBM Enterprises Initiatives (Armonk, New York, USA); ***David Ing*** (IBM Marketing Scientist, Toronto, Canada) for **Waldemar Karwowski**, Ph.D., Professor and Chair Industrial Engineering and Management Systems, University of Central Florida (Orlando, USA); **Naoki Saito**, Director, RISTEX, JST (Tokyo, Japan); **Yuriko Sawatani**, Fellow at RISTEX, JST (Tokyo, Japan); **Marja Toivonen**, Ph.D., Director, Adjunct Professor BIT Research Centre, Aalto University, School of Science and Technology (Finland); and **Stephen L, Vargo**, Ph.D., Shidler Distinguished Professor of Marketing at the University of Hawaii at Manoa (Honolulu, USA). Kyoichi Kijima facilitated the panel discussion which included **Hiroshi Deguchi**, Ph.D., Professor and Director of the Center for Agent-Based Social Systems Sciences at Tokyo Institute of Technology (Japan); **David Ing** (IBM Marketing Scientist, Toronto, Canada); and **Gary S. Metcalf**, Ph.D., President InterConnections, LLC (USA). Other participants included Anne Denuziere from Laboratoire de Chimie Analytique (Lyon, France), Kazuyochi Hidaka, Ph.D., from Tokyo Institute of Technology (Japan), Henri Hietala from Nordic Healthcare Group (Helsinki, Finland), Mayumi Itakura, Ph.D. from IBM (Kanagawa, Japan), Hironobu Matsushita from Tokyo University of Agriculture and Technology (Japan),

Michael Norton, Ph.D., from Shinshu University, Santi Novani from Tokyo Institute of Technology, Minni Sarkka from Aalto University (Finland), Takao Terano from Tokyo Institute of Technology, Jennifer Wilby, Ph.D., from University of Hull (Kingston, UK), and Katsushi Yamashita from IBM (Japan).

Kyoichi Kijima opened the intensive workshop on Sunday morning by introducing David Ing, Gary Metcalf, and Jennifer Wilby and outlining the design of the workshop. A key objective of the workshop was stimulation of shared ideas and collaboration that would leverage the connection between systems science, systems engineering, and service science. David Ing summarized three types of conversations as 1.) Orientation – based on generative dialogue (Banathy, Bohm), 2.) Possibilities – based on inquiring systems (Churchman, Singer), and 3.) Action – based on commitments (Flores, Winograd). Participants in these conversations had different roles as core members who present current research, facilitators who guide inquiry synthesis that incorporates content, and contributors who ask questions and provoke ideas.

The basic format for presentations during the two days of the workshop entailed each SME answering an introductory question to provide orientation and to generate dialogue, a slide presentation of their research focus to stimulate inquiry for possibilities, and comments for synthesis and possible action. The introductory questions included the following: a.) What do you are about in service science, b.)Why is it important to you, and c.) Why did you decide to attend this meeting? Presenters were grouped into clusters of three with a facilitator who concluded each group with a collective integration of emergent ideas from the three presentations. At the conclusion of the second day of the workshop, moderators from each group that had presented facilitated reflection clusters that contemplated implications of what had just been heard and seen. Two questions guided the dialogue: 1.) What new themes have you synthesized as a result of the workshop, and 2.) What might we do with this joint learning? The following section summarizes some of the core ideas shared by each SME during the workshop.

PRESENTATIONS – FIRST GROUP

Colin Harrison is a storyteller whose goal is to help people understand what is going on in an emerging area with direct impact on their lives – smarter cities. His connection to service science is through Jim Spohrer (IBM Almaden). Dr. Harrison believes it is important to build a structure for systems science. His presentation focused on ten years of development of the concept of smarter cities, which emerged from an IBM Innovation Jam. Energy and the environment also emerged as pivotal issues that will drive future urban planning, architectural design, and community dynamics. Comments from participants identified the smarter cities model as an activity-based, hierarchical approach based on social construction. Inquiries from the participants explored how to adapt the model for cultural considerations, as well as ethical implications.

Foong Sew Bun is also familiar with Jim Spohrer's work and applies it at IBM Singapore. Based on his experience in Singapore, Sew Bun believes that the smarter cities approach will address complex issues in urban planning by more clearly identifying a city's agenda and tackling its toughest problems. Sew Bun believes academia and industry share common interest in these challenges. His slide presentation was a case study of Singapore as a model for smarter cities

with a vision of the Island State as a "gracious city." Moving beyond silo thinking is fundamental in making this vision and model work. As a specific example of Dr. Harrison's model, Singapore presents some intriguing possibilities for sustainability, energy, the environment, and community development.

Mayumi Itakura believes that huge, complex problems need both scientific and holistic approaches to address human issues from different perspectives. Her presentation focused on designing a smarter planet resulting in higher efficiency, productivity, and responsiveness. She sees the smarter planet develop from focus on value, exploitation of opportunities, and responding with speed. Application of ideas from service science, management, and engineering (SSME) provides the foundation for her conceptualization of services as theatre. The metaphorical reference was one of many throughout the remainder of the workshop. The introduction of metaphor highlighted the need for development of a service science language, perhaps based upon science, engineering, management, and social systems science (e.g. SSME, SSM).

EMERGENT IDEAS – FIRST GROUP

The first three presentations initiated dialogue about developing shared meaning, language, models, and metaphors for a service systems science discipline. Some thought provoking questions emerged from the dialogue such as: Where do people fit into these processes? What is the definition of smart? What is the definition of sustainable? Participants identified the need for community involvement for the development of a smart city, especially with the goal of continuous improvement. A full cycle approach including education and employment was suggested, encompassing the role of social media and ethical implications for privacy (i.e. behavioral tracking of service usage).

PRESENTATIONS – SECOND GROUP

Jennifer Wilby, Ph.D., is interested in the relationship between Systems of Systems Methodologies (SOSM) and service systems science. SOSM (Jackson, Flood, Keys) provides a framework for examining perceived system behavior (i.e. what the system does and what it could do) and observing isomorphies between disciplines. The process of SOSM supports the emergence of isomorphies and other systemic principles (Boulding, 1956) within an analytical context that provides for the problem of using the wrong level of analysis and discipline to inquire into or solve problems at another level. In other words, SOSM can be a useful framework to avoid inappropriate and inaccurate application of isomorphic properties to transfer theory and practice into a new discipline. Participants appreciated this issue, especially in the application of IT when it is relevant, not as a panacea. Participants pointed out that SOSM provides a helpful bridge between soft and hard disciplines (e.g. SMART, engineering principles and SSM, sociology). Provocative questions derived from Dr. Wilby's presentation included: How do we define the boundaries of the system we are designing (open/closed systems)? What value for whom?What are the unintended consequences of our design decisions?

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Stephen Vargo, Ph.D., has come to the realization that he is "not very smart" and he needs "a way to understand a complex world. We need a language for it." He is driven by his inquires into value creation relative to service science. His presentation focused on "Service Dominant Logic as a Foundation for a Science of Service." In Dr. Vargo's view, we have an antiquated model to service delivery based on "goods-dominant logic." This model focuses on producing and distributing tangible good whose value is embedded by their utility. The goal of this model is to maximize profit through efficient production and distribution of goods. Dr. Vargo suggests that this model no longer serves the services economy because it focuses on the product instead of the consumer relationship (i.e. the customer is co-creator of value), a much more appropriate focal point. As a result, the customer becomes a source for co-creation of innovation. This shift away from product orientation to consumer relational orientation has implication for markets. As a service economy grows, markets shift away from commodities and consumers revolving around processes to systems of practice collaborating in value creation. Participants acknowledged that service systems science is not "about stuff (products are not the center of the economic milieu)." Participants pointed out that "goods dominant logic" has been a primary driver behind sustainability issues today. A distinction was made about the difference between "servicing," as in taking your vehicle for service (object oriented), and the mindset "to serve" or "be in service to" (relational). A key point in the discussion was the application of "Service Dominant Logic" for sustainability, possibly in conjunction with the Viable System Model (VSM) (Beer, 1972).

EMERGENT IDEAS – SECOND GROUP

The integration of this group's ideas encompassed the presentations by Jennifer Wilby and Stephen Vargo, due to the absence of a previously scheduled SME. In relating this group's presentations to those of the first group, the participants observed that social construction may be a way to relate "Service Dominant Logic" to Colin Harrison's SMART city model, connecting and integrating its multiple levels. An analysis using SOSM may provide insight into relevant isomorphies between the two as well.

THIRD GROUP – PRESENTATIONS

Kazuyoshi Hidaka graduated from Tokyo Institute of Technology with a degree in nuclear physics and spent 25 years in IBM research. He is currently a Professor in the Department of Management of Technology in the Graduate School of Innovation Management at Tokyo Institute of Technology. He sees service systems science as an emerging discipline that will integrate his interests. His presentation explored his research into several trends now facing Japan such as global competitiveness, access to resources, superaging, economic maturity, medical care crisis, and employment in terms of Japan's strengths, weaknesses, opportunities, and threats (SWOT). He suggests the use of simulations to address these issues, especially for green innovation and global optimization. Participants noted the convergence and divergence of servitization and de-servitization, such as electric vehicles. An essential step toward developing holistic models is facilitating relationships between the silos. The "service dominant logic" approach using value co-creation may be helpful in this process.

Hiro Matsushita's experience as an entrepreneur in healthcare and Professor of Technology and Management brought his to this workshop in search of a framework for innovation of services, specifically in Human Resources Management and Healthcare. He presented a case study of Kurashiki Central Hospital, which is a key acute care provider in western Japan. Before intervention, the hospital had a 10-20% turnover rate with low job satisfaction, a high burnout rate, and a high accident rate. Mr. Matsushita's two-fold objective was to 1.) increase patient satisfaction by increasing employee satisfaction and 2.) increase the quality of direct healthcare service. To address these issues, he used management of accountability and management by objectives approaches. This successful case of transformation (KCH was nominated as a "benchmark institution by the Japanese Nurses Association) demonstrated to Mr. Matsushita that systems of systems methods need to be co-created between management and healthcare teams, possibly through a knowledge support system using cloud computing. Participants suggested that SSME may be useful in healthcare because of the multiple levels of interaction in service delivery and the sharing of information and knowledge is critical in delivery of care. This was another case where development of shared meaning, language, models, and metaphors would be useful in the application of service systems science.

David Ing seeks a bridge between IT, service systems research, and social systems science. Looking toward 2015, Mr. Ing's presentation highlighted opportunities for advances in science, management, engineering, and design through systems science and natural systems. He outlined four major areas of focus including 1.) theory emphasizing how the invisible becomes visible, the unobservable becomes observable, shock and coevolving, systems that persist and are sustainable or change state to alternate forms), 2.) methods and tools such as social media, model driven systems development, and model based systems engineering (INCOSE), SysML, method composition, and work products (Eclipse), 3.) frameworks such as the Municipal Reference Model (MISA Canada), the Programs and Services Reference Model (Government of Ontario), and 4.) education, specifically an alternative to MBA education (e.g. a Masters program in Creative Sustainability that addresses systemic thinking of sustainable communities and systemic thinking for planners and designers).

EMERGENT IDEAS – THIRD GROUP

A common theme expressed in this group was the implication of superaging populations on service systems design. Integration of disciplines and the development of a common language persisted as an identified need in service systems science. A provocative question was raised by participants about how to introduce a perturbation into a service system and how that may be modeled.

PRESENTATIONS – FOURTH GROUP

The second day of the workshop opened with a welcome, introduction, and reflection by Kyoichi Kijima. Observing the use of metaphors used during the first day of the workshop, Mary Edson shared a quote from E. M. Statler (hospitality),"Life is service – the one who progresses is the one who gives his fellow man a little more, a little better service." She summarized key points from the first day. First, the orientation of services systems needs to put humans in the center of

the model. Second, design and selection of models need to be relevant. If we use existing models, we need to compare, contrast, and integrate service systems values (humanistic) and priorities into our development of service systems science models. Third, developing shared mental models and metaphors requires a specific language that will facilitate understanding of service systems science within and outside the discipline. The format for the second day of presentations remained the same as the first.

Marja Toivonen observed that the effective use of case study to illustrate service systems science issues in the first day's presentations. Her purpose for attending the workshop was to continue a research relationship between Tokyo Institute of Technology and Aalto University. Dr. Toivonen's presentation focused on value co-creation in service innovation. Her approach is to bring the "user" (i.e. customer, citizen, consumer) to the fore of service design. Dr. Toivonen outlined service design based on three dimensions of customer knowledge. First, build customer understanding based on knowledge on customers (e.g. customer description). Second, service blueprinting uses mapping to reveal goods versus services dominant logic when knowledge from customers is gathered (e.g. what do customers know about other customers needs). Third, understand that the service provider must inform customers about how to conduct a successful service transaction (e.g. how to develop skills to interact with the service system for successful outcomes). Using case study and other narrative research methods facilitates this understanding, as well as increasing awareness and supporting genuine co-creation of service value. Dr. Toivonen's presentation prompted curiosity by participation about how their organizations might use this research approach for service innovation.

Hiroshi Deguchi, Ph.D., finds service systems science a synthesis of his diverse educational and professional background in mathematics, philosophy, and sociology. He sees no boundaries between disciplines and focuses on the use of language to convey ideas. Dr. Deguchi's presentation focused on "Innovation Design of Social and Business Service System and Its Platform." The platform has three stakeholder interactions: 1.) the customer, 2.) the platform service, and 3.) the application service provider. Dr. Deguchi emphasized the importance of interorganizational relationships, particularly vertical integration. He compared the dynamics of a large shopping mall with local, urban shops/restaurants. Then, he introduced the new platform using technology and social media (e.g. Google, Twitter, Facebook) as an example of multiple levels of service imposed on a foundational platform. This new platform is built upon agent based social systems. Participants noted that web-based design for services gives complex organizations the ability to bind multiple different types and layers of services in what would be thought of as a business platform itself. The implication of hypervariety was explored, as well as how hospitals might use this approach to patient services.

Louis Freund, Ph.D., started a course about service science at San Jose State approximately four years ago with colleague, Steve Kwan, Ph.D. The course focuses on quality control in a co-production context. In addition, Dr. Freund is co-chairing with James C. Spohrer, Ph.D., the 4th International Conference on Applied Human Factors and Ergonomics in San Francisco, July 21-25, 2012. Dr. Freund's presentation focused on the impacts of customer performance variation. He highlighted missing elements of both quality and process control in the Service Quality Gap

Model. Co-production assumes that both the service provider and the customer have inherent responsibilities in the outcome of the relationship. As a result, "customer performance" in terms of expected behaviors (e.g. accessibility, competence, ergonomics, perception, cognitive factors, and processing capability) is an essential consideration in service design. The intersection of the two agents reveals a joint specification region with nine possibilities. What happens when customer performance operates outside the upper and lower limits impacts service design, such as self-serve kiosks and check-out stations? Customer feedback informs the service provider and helps close the satisfaction gap. Participants noted that customers may have the same experience but report different levels of satisfaction. Customer satisfaction operates on a continuum, but it is discreet. Measuring customer satisfaction with precision is highly desirable. Questions about attaining commitment from customers regarding their performance led to discussions about service agreements.

Gary Metcalf, Ph.D., shared his perspective from his background in family systems therapy, family constellations, corporate employee assistance programs, and as an adjunct professor in organizational systems at Saybrook University. His participation in this workshop was compelled by the question, "What does service science bring to systems science and vice versa?" Dr. Metcalf's presentation focused on modeling service interactions and highlighted dynamics of trust, empathy (anticipation of others needs), altruism, autonomy, and power between the service provider and the consumer. In "goods dominant logic" there is an implicit predator orientation in the relationship. What will the orientation look like in a services model – predator or prey oriented? There is an exchange of transactions and relationships. In this context, what does exploitation mean? Is responsibility individual or shared? Revisiting Dr Wilby's point about establishing a clear definition about the value of the service and for whom it was designed, Dr. Metcalf went another step to add, "What value for whom and at what level?" Participants noted the phenomenon of unintended consequences and compensatory behavior operating in this relationship, perhaps as a way of reestablishing some equality or even primacy. Use of online shopping reviews is an example of using knowledge to compare products and services to find the best value and fit for customers. This level of information and discernment has shifted the power dynamic toward consumers to some extent. Participants also noted the cultural context as influential in how values are behaviorally expressed and service value is perceived.

EMERGENT IDEAS – FOURTH GROUP

The fourth group's underlying themes addressed all three of the issues introduced at the opening of the second day of the workshop. First, the orientation of services systems needs to put humans in the center of the model. Second, design and selection of models need to be relevant. If we use existing models, we need to compare, contrast, and integrate service systems values (humanistic) and priorities into our development of service systems science models. Third, developing shared mental models and metaphors requires a specific language that will facilitate understanding of service systems science within and outside the discipline. Co-creation facilitated by involving customers at every level of the service design process is ideal, whether through gathering customer intelligence or feedback. While humans should be the center of service systems science models, it is important to remember that the service system relationship has at least two primary

roles (provider and consumer) with corresponding responsibilities that require commitments to engage and ensure successful outcomes.

PRESENTATIONS – FIFTH GROUP

Katsushi Yamashita seeks a common point for issues, interests, and concerns he has in service engineering, particularly in the context of cloud computing. His presentation, "Reference Architecture of Service Delivery," focused on simplifying the process because service delivery is time consuming. Simplification entails use of a service portfolio, a reference architecture definition, and navigated communication with customers. This architecture is based upon standardization of service delivery with clear description of the service provided leading to best practices to lower costs for higher profitability. The service description needs to be brought from service architecture (reference architecture and methodology/language). This translates to navigation of conversations between users and automated service providers (cloud portal). The user interface minimizes human interaction by not requiring it, which controls client expectations of services and limits collaboration with customers, thus preventing over-reactions to customers. Participants noted the level of relational commitments in designing services using a platform like cloud computing, which relies upon tracking behaviors in a patternized manner. Questions about risk evaluation were posed, especially concerning customers' abilities or inabilities to identify their expectations and define them sufficiently. The group explored the difficulty of liberating expertise due to country (nation) limitations and other technical constraints.

Kyoichi Kijima, Ph.D., sees service systems science as an emerging discipline. Dr. Kijimi wants to customize Soft Systems Methodology (SSM) to a specific research field (industrial clusters) to activate (stimulate innovation and incite new value) them through collaboration using the principles from these approaches. Dr. Kijima's presentation, "Service Systems Modeling," provided a definition of service systems science in terms of co-creation. After discussing several modeling approaches, Dr. Kijima presented a two-sided platform (real or virtual) in which orchestrators provide a forum (environment) for service providers and customers to interact (transaction) with mutual benefits resulting in value co-creation. The platform facilitates stakeholder interactions. Participants noted that a two-sided platform may not fully represent the complex interactions of stakeholders and suggested that a multi-sided model (e.g. circle) may be a possibility. In doing so, the group recommended moving away from linear models to dynamic models and ecologies. Finding appropriate language, metaphors, and models resurfaced as a need in developing service systems science as a discipline.

Yuriko Sawatani met Dr. Kijima and found a discipline that encompassed her interests and experience in technology and service research. Ms. Sawatani's presentation, "Research on Service Innovation in Knowledge-Intensive Services: Analysis based on Value Co-creation," outlined the market shift from goods to services economy. She observed that goods innovation has been incremental because the market remains skeptical and feedback from customers has resulted in refinements rather than radical innovations. Ms. Sawatani sees collaboration studies as a path to innovation processes. She also sees a need to synthesize service science (R&D) and research activities into one model to achieve service innovation goals. There are different

focuses, orientations, operating processes, and management styles; however, some transformation is necessary to bridge differences and leverage strengths (i.e. inherent risk in change). The service dominant logic view of research centers on value co-creation which is foundational to a synthesis model of service research. Facilitation of service innovation through value co-creation requires the transformation of both organizations. Specifically, the management system of R&D needs to transform to accept diverse research themes, and facilitate multidisciplinary research activities. Participants agreed with Ms. Sawatani's key point, noting that they also felt that significant levels of facilitation for transformation would be required from both sides for co-creation to occur. Ideally, an architect would guide the relationship between the two.

EMERGENT IDEAS – FIFTH GROUP

The dominant theme throughout the presentations of the fifth group was developing a structure, framework, or architecture for the service systems science discipline. It was evident from the presentations that identifying the key roles, responsibilities, environments, and expertise is essential. The level of participation in value co-creation needs to be determined by service system designers and, at a higher level, those in the discipline, including researchers, in collaboration with one another. Whether collecting knowledge through customers and simplifying processes to streamline provider/customer interactions, to modeling and research, an underlying theme in the fifth group was ensuring that the knowledge applied in service systems design was relevant and value producing.

At the conclusion of the presentation, the workshop participants split into several work groups (reflection cluster) to reflect on, synthesize, and integrate the information shared in the presentations. Once the work groups concluded their discussions, the workshop reconvened to listen to reports from each work group.

REFLECTION CLUSTERS

Three reflection clusters (work groups) reported common themes and recommended next steps (what to do) for the learning gained through the presentations. Some of the major ideas highlighted include: 1.modeling needs are both general (unifying principles of service systems science) and specific (SMART cities), 2.) value co-creation is linked to innovation effectively when there are shared values in the ecology, 3.) progression of levels entails shifting from service design to defining relationships, 4.) enhancing the customer experience starts before engagement (front stage, front of the house, front office), 5.) scalability of service systems through servitization (relates to "user" concept), 6.) drawing boundaries has implications for value co-creation, 7.) systems science has some useful frameworks for service science and can inform each other, 8.) evolution from centralized (smart) to decentralized (stupid or kewl), 9.) simulations of cities for service design, 10.) developing a creative platform that integrates service ecosystems and resources. Ultimately, all these ideas have value when they are understood fully and executed accordingly.

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WORKSHOP SUMMARY

The workshop brought together leading researchers, educators, and practitioners from North America, Europe, Asia, and Japan to share experiences and exchange expertise related to service science, management, and engineering (SSME). Through participation in the workshop, these leaders clarified important concepts, practices, and challenges in a collaborative venue using a systems science perspective. The workshop dialogue set the stage for the open symposium, in which several of the workshop participants shared their experience from the forefront of the field and their visions for the future of service systems science. Representing Waldemar Karwowski, Ph.D., David Ing presented "Modeling of Complex Service Systems: A Systems Engineering Perspective." The presentation focused on three major challenges: 1.) managing complexity using Systems of Systems (SoS) in a fusion of management, human factors, systems science, network science, and modern systems engineering to develop adaptive SoS and optimizing resilience, 2.) application of relevant knowledge to satisfy human system interaction requirements and mitigate technological and economic risks, and 3.) modeling emergent behaviors of complex service systems. The symposium concluded with a panel discussion about state-of-the art approaches to advance the field of service systems science. The panel discussion emphasized the recommendation to view service systems as ecologies. This theme was at the core of the several workshop presentations, including Dr. Waldemar's challenges (adaptation, resilience, risk mitigation) and the drive for innovation in service systems. This paper presented a summary of the workshop proceedings and shared ideas about next steps in the development of the field of service systems science. Those interested in the development of service systems science are encouraged to contact Kyoichi Kijima at the Kijima Laboratory,W9, 8th floor, Tokyo Institute of Technology, 2-12-1, Ookayama, Meguro-ku, Tokyo, 152-8550, Japan.