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Modern solutions for scientific problems and the implementation of innovations in the Russian pulp-and-paper industry

The Pulp-and-paper industry (PPI) historically has been one of the most important industries in the Russian economy and has considerable development potential. Its perspectives are determined by several factors: An inevitable shift towards sustainable development, based on the growing use of renewable raw materials of plant origin, the largest raw materials inventory of high-quality wood, and above all – considerable and constant assimilation of home and foreign markets, especially of sanitation goods, shipping materials, plus coated and special papers. At the same time there are a variety of serious problems which impede the industry's development. Chief among them are the high capital intensity of manufacture, long payback periods of investment, and the considerable ecological problems which are created by PPI factories.

The creation of the state system of support for priority investment projects has slightly enlivened the investment process of the industry, but has not made any radical changes to the situation. These issues are becoming more marked and substantially decrease the competitive opportunities of home producers. Among them: disunity in research work during facility modernization, the development of modern technologies, the launching of new products which are in market demand, providing integration of various wood types, and the training of personnel with middle and higher education degrees in accordance with the real needs of science and the industry. The number of branch and inter-branch scientific and project organizations has decreased significantly; the number of their personnel and graduates who are appointed to the core business has also decreased. Financing for scientific research by corporations has dropped to a critical level, and PPI enterprise authorities prefer to use foreign scientific and project design centres to solve the most urgent problems of modernization.

Nevertheless Russian scientists and developers continue to make significant contributions to the development of this science and industry at home. This is due to the preservation of a number of structures of the Russian Academy of Sciences (RAS), some departments of the Saint Petersburg State Technological University of Plant Polymers (StPb STUPP) and other institutions of higher education. The staff from certain departments of former all-USSR scientific and

project organizations also take part in this constructive process. Therefore there are opportunities to create conditions for a radical change in the current situation: to arm the sector with advanced manufacturing sciences, to equip PPI enterprises with modern equipment and to train highly qualified personnel based on timely and highly effective scientific developments, so that it will favour the entry of Russia into the ranks of leading countries of timber processing. The consolidation of these "islands" of academia and sectors of scientific and project organizations to form a "centre of crystallization of productive ideas and effective decisions" for business projects could be one of the steps in this direction. The effectiveness of such an "R&D project office" would depend on several factors, and in the initial stage – from "organizational-infrastructural" and "creative-communicative" components.

Organizational and infrastructural component consists of creating an open multidisciplinary research and educational cluster in Saint Petersburg, which would include institutes of higher education (scientific and educational core and resource base), enterprises of the sector (manufacturing core, testing area) and certain subdivisions of the largest project and scientific organizations from the immediate past (intellectual opportunities and archives). Taking into account the fortunate location of SPb STUPP – its closeness to the historical centre of the city, the metro station, and parking lots – the areas of the university, including its buildings and constructions, which are being used or need repair, could become the basic territory for the cluster. Any large manufacturing corporation could become an anchor investor, if its business strategies help support and develop competitive advantages such as the use of effective advanced manufacturing sciences and the development and distribution of new products which are in market demand. Home PPI enterprises would become the main clients of their scientific developments and trained personnel. It would also be reasonable to expect federal and interested regional authorities and the largest sectored organizations to participate in financing the creation and maintenance of such a scientific research cluster as authorised by the RF (the Russian Federation) under the mechanisms of Technological platforms and private-state partnership, which have proved competent, including the prolongation of a Decree of the Government of the RF 218 dated April 9, 2010.

The "Creative-communicative" component is created through conditions which allow members of the organization to easily interact throughout the chain of development, from the idea which was born within the walls of the scientific institution to the implementation of its development, to the production and the opportunities arising thereof. The present global Internet network infrastructure

lets any organization and/or person contact each other easily and at a reasonable cost to discuss the organization and running of a business, joint scientific efforts, exchange of ideas and know-how, etc. regardless of their geographical location.

Due to developments in network technologies, the degree of heterogeneity in the modern communication environment is decreasing. In fact a new environment, where it doesn't matter how information is exchanged – by means of either a cable connection (air, underground, underwater), or wireless communication (cellular over ground or satellite, or a combination of the two), or others, is appearing. Different types of media, such as digital data, text, sound, video and graphics, converge in this environment. Such a convergence of media makes it possible to state that the development of network technologies where communication by means of paper information media and also direct contacts of people so far play a significant role, is becoming more homogeneous.

The Homogenization of the communication environment is in essence a new, powerful factor in increasing economic efficiency. Companies must bear the costs of both tangible resources such as labour and raw materials and intangibles such as information and knowledge. In the economy which is based on traditional discrete communication, a share of intangible costs, which include costs for information search, regular exchange of it with partners and clients, regular monitoring of competitors' actions and so on, constitutes an essential part of business costs. Firstly, using the opportunities of a new communication environment decreases these costs by several times. Secondly, distance stops being a factor which limits the effectiveness of collaboration. Thus, a phenomenon of continuous communication is appearing along with a new view of scientific work organization and research project management. At the core is the researcher, a person of high activity and mobility, who should have all means of communication at hand, which provide immediate access to almost any information and allows the free flow of information without any barriers.

From these considerations one can decide the basic requirements of an information technology that could allow the implementation of the "creative-communicative" component, which aims to facilitate effective collaboration and interaction among all participants of the process "starting from the idea and up through the commercially successful product".

It goes without saying that the technology should provide standard opportunities for video, audio and word communication both in private and in broadcasting. When working collaboratively, the participant not only communicates with words, but also makes eye contact and perceives the timbre of voice, intonation, facial expression and gestures. Words reproduce the meaning

of information, and gestures, facial expressions and voice add to this information by giving it a certain "colour." Studies show that up to 70% of information in communication between people can be transmitted in a nonverbal way. That is why functioning video transmission of a quality not less than 720P HD, which allows the participants to clearly see the nonverbal reaction of their colleagues, is compulsory in a collaboration tool in order to provide maximum productivity of interaction.

Participants of a collaborative session com with different experiences, skills and levels of knowledge when using information technologies. That's why it is necessary to have an intuitive and ergonomic interface which allows a participant, who has recently joined the communication, to fully participate in the collaborative session with his colleagues, including remote ones, almost immediately without any special training. Participants should also have the ability to easily take part in the collaborative session from any part of the world even by means of 3G technologies, and naturally, the tool should minimize the network load generated by such traffic.

Without a doubt the participants of the collaborative session should have the ability to work together on documents, make reports, presentations, and if it is required – to take part in experiments for operating devices and equipment without interruption of visual contact. The technique of document exchange should be as simple as a physical exchange of documents "from hand to hand", and naturally there should be the ability to send files with one mouse click while having visual contact.

Participants should also have their collaborative session secured by a communication traffic encryption algorithm, which is standard and understandable for IT security specialists of both participating organizations and a nation's public authorities. These specialists should be confident that use of the collaboration tool is not a threat for either the IT structure, or a secret of the participant or organization where he works.

The collaboration tool should have an effective protocol for adapting to present network conditions and making it unnecessary to upgrade the present network infrastructure of the organization. At the same time it should be easy to scale to enterprise needs. Ideally, the tool described above should not charge for services based on "limiting the number of simultaneously working participants" and "duration of collaboration", but would be based on a "freemium model" which is vital to participants and organizations which are operating in conditions of strict budget limits, uncertainty in financing, and which have out-of-date and often archaic network infrastructures.

A viable collaboration tool which meets the above requirements of providing a geographically divided team with the ability to effectively interact with each other is the Stanford University developed tool named VSee. This service became the means for organizing the interaction of specialists and scientists of SPb STUPP not only within the university, but also with geographically remote colleagues for the complex project "The development of innovation technology for complex processing of larch wood (with the release of a new type of market cellulose)." This project, which was allotted 300 million roubles for the period of 2010-2012, is financed in equal shares by both the Ministry of Education and Science of the RF and one of the leaders of the home pulp-and-paper industry – OJSC «Group "Ilim"».

The VSee service, which works on XMPP protocol, is a system of visual collaboration for a potentially unlimited number of participants, which differs for example, from Skype, the aim of which is voice communication first of all. Besides, as opposed to the Skype service, VSee doesn't economically limit the number of participants in a video conference; rather it is limited only by the capacity of the Internet channel and the processor power of a user's computer. Every participant's video, as a rule, generates traffic of approximately 120-150 kbps, which is normally enough for the collaboration of 3-7 people. The data itself is encrypted with 256-bit key by an AES algorithm, meeting the requirements of FIPS 140-2, and goes through ports 6000-6254 using automatic HTTP/SSL tunnelling.

A comparison of VSee service with other similar competitive services has shown, that these other services either require significant budgets – both for their first launching and for support of their complete features, or they offer a number of features which don't allow the full realization of the creative-communicative component of a scientific-innovative chain. While VSee has a paid option for the customization of program features and technical support for users, participants of this study have not had any need to use the technical support services of VSee or felt any inconvenience while using this program.

Due to this collaboration tool, it has become possible, for example, to quickly discuss the questions of geo-monitoring of larch reserves in Russia while participants are connected to a satellite geo-system of the Space Research Institute of RAS. Interaction with the Institute of High-Molecular Compounds of RAS was just as effective for the participants of a project research group as they discussed the real-time results being generated by a powerful electronic microscope to which they were connected despite of being thousands of kilometres away.

It is safe to say, that the project "Listvennitsa" ("Larch") in fact became a

catalyst in the process of forming the “R&D project office”, which unites the efforts of geographically divided organizations in different departments on a modern level.

SPb STUPP is ready to share its present experience of the VSee service for collaboration with SibNII CBK (Bratsk), EEK OON (Geneva, Switzerland), Abo Academy (Turku, Finland), the Institute of Chemical Physics of RAS 9Moscow, Russia) and other organizations with interested parties. The team, which was formed during the project “Listvennitsa”, has proposed to use VSee to organize projects for the professional development of technical staff in sectored enterprises, which is an opportunity to involve internationally renowned scientists and specialists leading foreign and Russian universities, research academies, and corporate R&D centres. Moreover VSee can be successfully used in the educational process at the correspondence department and also for professional development of manufacturing staff in the “Krona” institute of SPb STUPP.

In conclusion, one can still remember when nearly half a century ago Lev Efremovitch Akim, who was the head of wood and celluloid chemistry department of Leningrad technological institute of the pulp-and-paper industry, installed in his department the first industrial television in the country and 2 electronic microscopes so students could see the structure of cellulose and wood. Since then breakthroughs in media have created completely new opportunities for intellectual interactions. Thanks to the success of combining the interests of authority, big business and scientists, we now have the ability to reach a new level in the search for new effective solutions. And whether we succeed in dynamically moving forward or widening the distance behind the world’s leading timber industry depends on whether or not business representatives take an interest in economic innovations and the efficiency of targeted state support.